MAINTENANCE INSTRUCTIONS

for

SURGICAL UNIT ARTHROSCOPIC, INTRA ARTICULAR
BATTERY POWERED, 120/230 VOLT, 50/60HZ AC
NSN 6515-01-318-1558
MIL-D-42048

Manufactured by
ZIMMER, INC.
HALL SURGICAL DIVISION
CARPINTERIA, CA 93013

CONTRACT DLA 120-90-C-8527

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INTRODUCTION

INTRODUCTION

This Maintenance Instructions Manual applies to the maintenance of the Zimmer Articular Power System (APS) Console (5039-22), the High Speed Handpiece (5039-26), and the Low Speed Handpiece (5039-27).

PRODUCT DESCRIPTION

The APS components are shown in Figure 1.

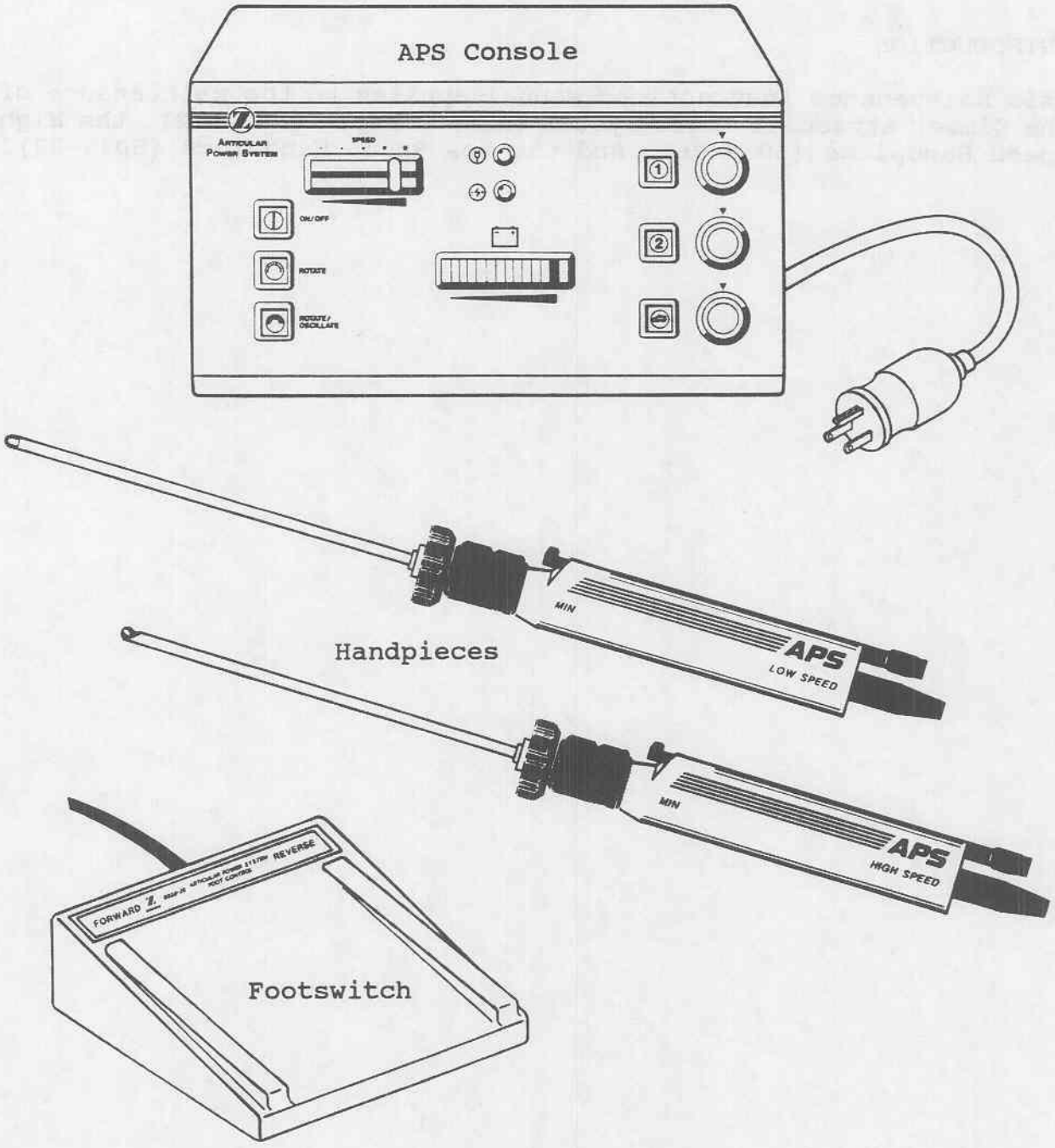
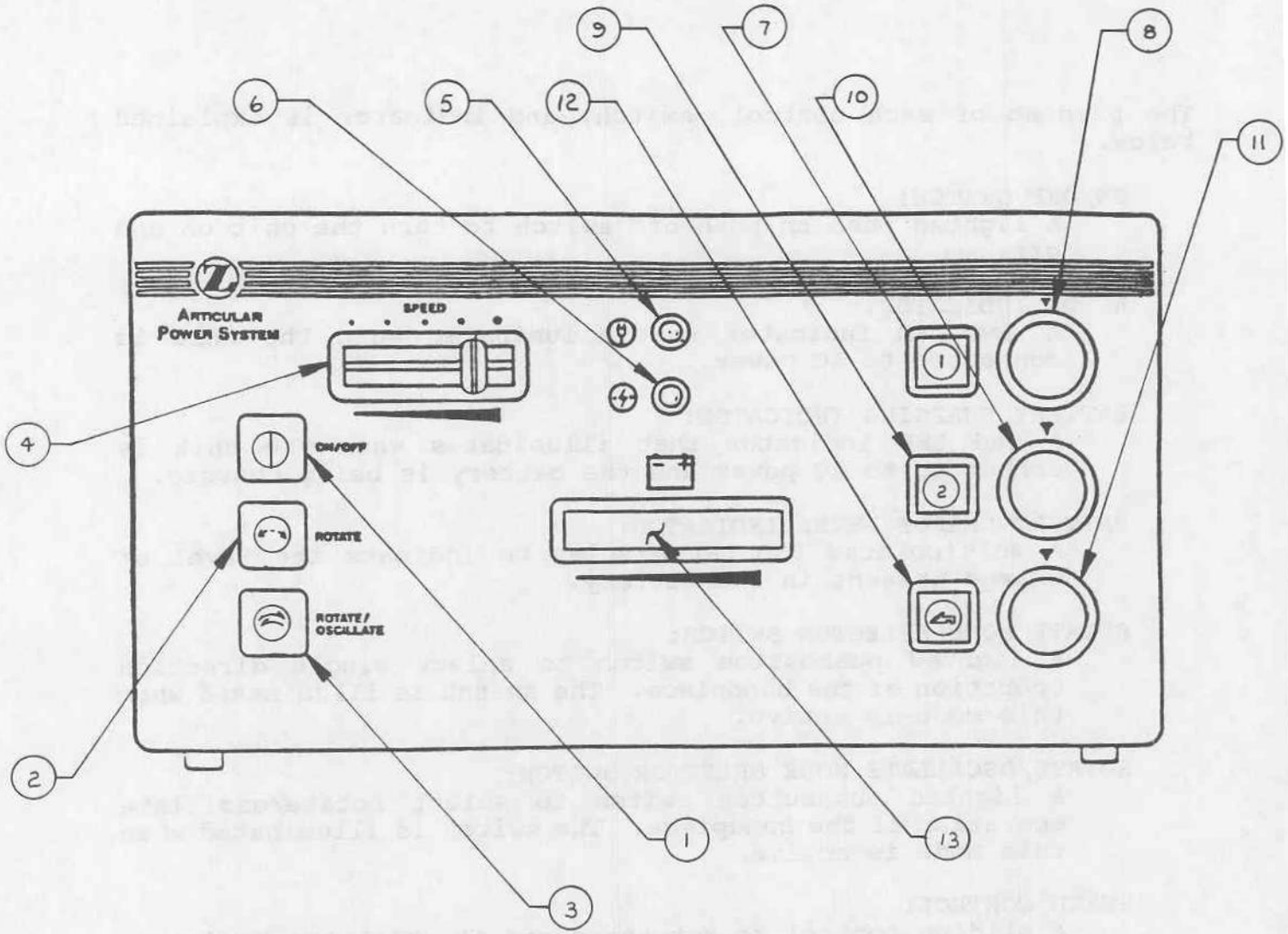


Figure 1. Articular Power System

The front panel controls and indicators are shown in Figure 2.



1. ON/OFF SWITCH
2. ROTATE MODE SELECTOR SWITCH
3. ROTATE/OSCILLATE MODE SELECTOR SWITCH
4. SPEED CONTROL
5. AC ON INDICATOR
6. BATTERY CHARGING INDICATOR
7. HANDPIECE 1 SELECTOR SWITCH
8. HANDPIECE 1 CONNECTOR
9. HANDPIECE 2 SELECTOR SWITCH
10. HANDPIECE 2 CONNECTOR
11. FOOTSWITCH CONNECTOR
12. FOOTSWITCH SELECTOR SWITCH
13. BATTERY CHARGE LEVEL INDICATOR

FIGURE 2. FRONT PANEL

The purpose of each control, switch, and indicator is explained below.

ON/OFF SWITCH:
A lighted push on/push off switch to turn the unit on and off.

AC ON INDICATOR:
A red LED indicator that illuminates when the unit is connected to AC power.

BATTERY CHARGING INDICATOR:
A red LED indicator that illuminates when the unit is connected to AC power and the battery is being charged.

BATTERY CHARGE LEVEL INDICATOR:
A multicolored LED bar display to indicate the level of charge present in the battery.

ROTATE MODE SELECTOR SWITCH:
A lighted pushbutton switch to select single direction operation of the handpiece. The switch is illuminated when this mode is active.

ROTATE/OSCILLATE MODE SELECTOR SWITCH:
A lighted pushbutton switch to select rotate/oscillate operation of the handpiece. The switch is illuminated when this mode is active.

SPEED CONTROL:
A sliding control to set the speed at which the handpiece will operate.

HANDPIECE CONNECTOR 1:
The connector receptacle for plugging in a handpiece which will be controlled by the HANDPIECE 1 SELECTOR SWITCH.

HANDPIECE CONNECTOR 2:
The connector receptacle for plugging in a handpiece which will be controlled by the HANDPIECE 2 SELECTOR SWITCH.

HANDPIECE 1 SELECTOR SWITCH:
A lighted pushbutton that selects Handpiece 1 as the active handpiece that can be operated. The switch is illuminated when this handpiece is active. Only one handpiece can be active at a time.

HANDPIECE 2 SELECTOR SWITCH:
A lighted pushbutton that selects Handpiece 2 as the active handpiece that can be operated. The switch is illuminated when this handpiece is active. Only one handpiece can be active at a time.

FOOTSWITCH CONNECTOR:
The connector receptacle where the footswitch is plugged in.

FOOTSWITCH SELECTOR SWITCH:
A lighted pushbutton which selects the footswitch as the method of controlling the operations of the handpiece. The switch is illuminated when the footswitch is active. This switch operates in a push on/push off manner. When the footswitch is active, the fingertip controls on the handpiece are deactivated.

HANDPIECE

The handpiece controls and connections are shown in Figure 3.

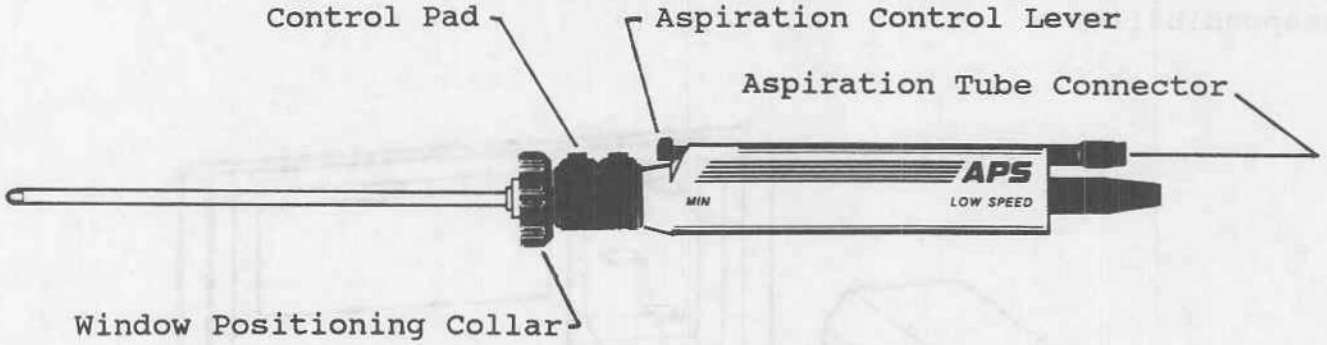


Figure 3. Handpiece Controls

The purpose of each Handpiece Control is explained below.

CONTROL PAD:
Contains two rubberized fingertip control switches. The operation of the switches are explained in Table 2.

WINDOW POSITIONING COLLAR:
A rotating collar which allows the open window of a cutter to be positioned relative to the control pad of the handpiece. The operation is explained in Figure 17.

ASPIRATION CONTROL LEVER:
A lever used to control the magnitude of aspiration (suction) applied to the cutter.

ASPIRATION TUBE CONNECTOR:
A place where the flexible aspiration (suction) tube is connected. The saline and tissue removed by the aspiration will flow through the tube.

INSTALLATION

OPERATIONAL SET UP

The APS should be removed from its carrying case and placed on a flat surface in the surgical environment. The handpiece(s) that will be used should be unpacked and sterilized prior to surgery. If the source of AC power present is 110 VAC, the unit should be plugged into the power source using the standard cord provided. The cord plugs into the console as shown in Figure 4. If the source of AC power is 220 VAC the 220V/110V transformer should be used. The short cord from the transformer should be plugged into the console as shown in Figure 4 and a 220V cord with an IEC connector used to connect the transformer to the AC power source. Because of the many different 220V cords and plugs available worldwide, this item is not provided with the unit and is the users responsibility.

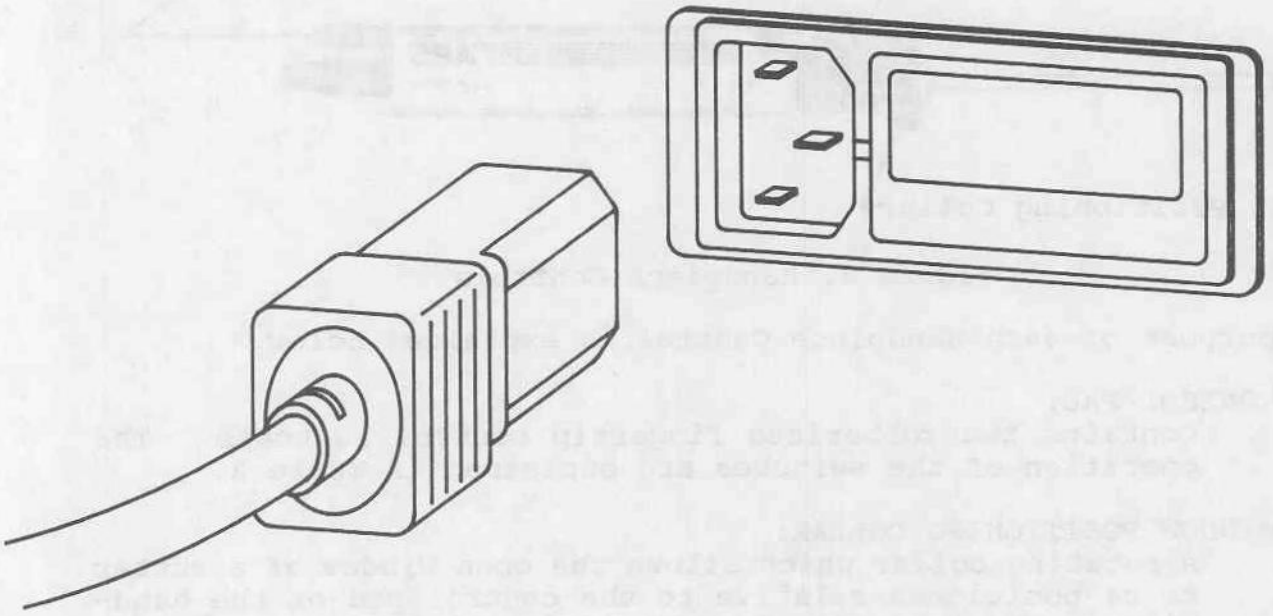


Figure 4. Power Cord Receptacle

CHARGING INSTRUCTIONS

The unit may be charged with the console on or off but the shortest charging time occurs when the unit is off (on/off button not illuminated). When the unit is connected to an AC power source, the red AC ON indicator and the red BATTERY CHARGING indicator are illuminated. See Figure 5. The unit may be left charging indefinitely. The built in battery charger senses the charge level and will maintain it at maximum after a full charge has been delivered. When the charging indicator light is off or is slowly flashing on and off the battery is fully charged. The battery cannot be overcharged.

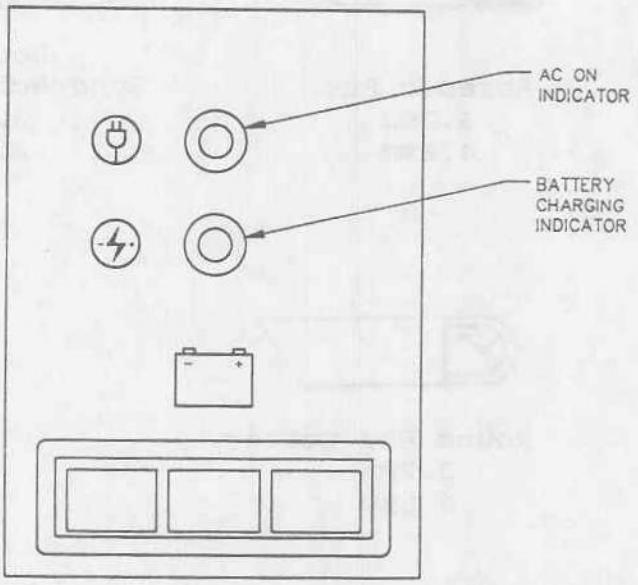


Figure 5. AC Indicator

The battery recharging time is approximately three times the run time. Example: If the unit is run for 15 minutes, to recharge it to the same level would require 45 minutes. An approximate charge time may be derived from the color of the bars on BATTERY CHARGE LEVEL INDICATOR after a procedure is completed and by consulting Table 1. A procedure should not be started unless the BATTERY CHARGE LEVEL INDICATOR is in the green area.

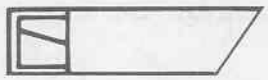
TABLE 1. CHARGING TIME CHART

POST SURGERY BATTERY LEVEL CHARGE INDICATOR	MINIMUM CHARGE TIME
GREEN	ONE HOUR
YELLOW	THREE HOURS
RED	FIVE HOURS

CUTTERS AND BUR

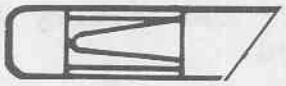
CUTTERS AND BUR ASSEMBLY

The cutters and bur used in the APS are shown in Figure 6.

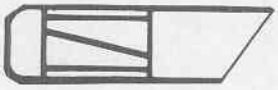


Flat End Cutter
3.2mm
4.8mm

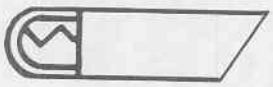
Abrader Bur
3.2mm
4.8mm



Double
Synovectomy Cutter
3.2mm
4.8mm



Side Cutter
3.2mm
4.8mm



Round End Cutter
3.2mm
4.8mm

Figure 6. Cutters and Bur

WARNING: Be certain cutters and burs are properly inserted into handpiece. Be certain the handpiece is in the OFF position before inserting or removing a cutter or bur.

CUTTERS AND BUR INSERTION

Align the cutter and bur drive coupling with the receptacle on the handpiece, making sure the key portion of the cutter/bur is placed into any of the four slots. See Figure 7.

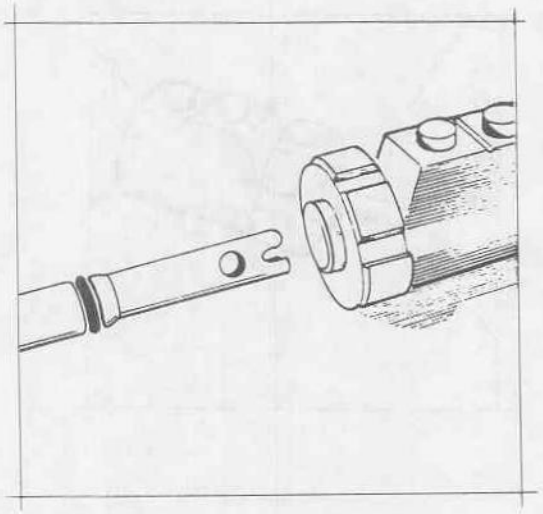


Figure 7. Cutter/Bur Receptacle Alignment

Firmly insert the cutter/bur with a push/twist motion. See Figure 8.

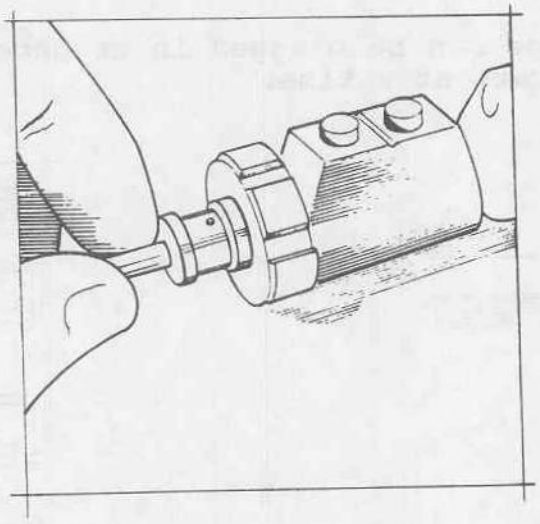


Figure 8. Cutter/Bur Insertion

Be certain the location key on the cutter/bur shaft is securely engaged into the key receptacle on the handpiece. Gently pull on the cutter/bur to ensure that it is securely affixed. See Figure 9.

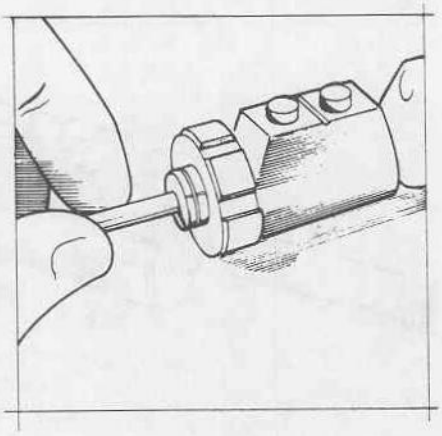


Figure 9. Cutter/Bur Insertion Check

HANDPIECE CONNECTION

Select either the #1 or #2 Handpiece connector on the console. Align the arrow on the handpiece plug with the arrow on the selected connector and insert the connector until seated. See Figure 10 and Figure 11.

Note both handpieces can be plugged in at once, however only one handpiece will operate at a time.

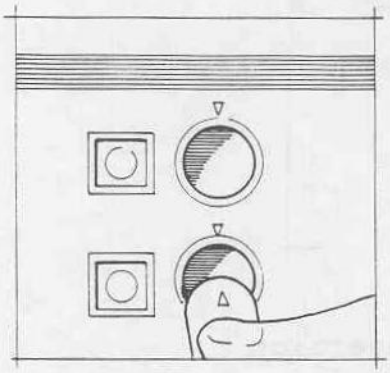


Figure 10.
Handpiece Connector Alignment

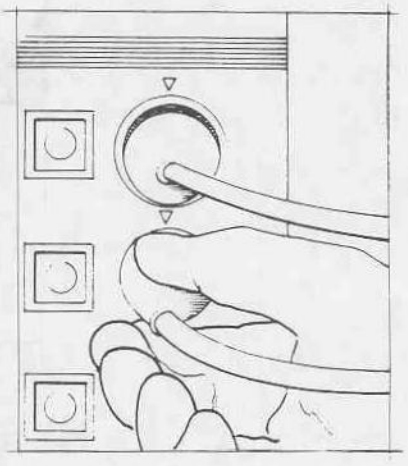


Figure 11.
Handpiece Connection

STORING THE APS

The APS should be fully charged before storage. The unit may be stored indoors at ambient room temperature and humidity. For outdoor storage the unit should be repacked in its carrying case and reusable shipping container. Outdoor storage should be between 35 degrees F and 110 degrees F at 0% to 100% humidity. The unit should be allowed to fully warm up to room temperature (60 degrees minimum) before use.

OPERATION

CAUTION: Inspect the power cord before using. A severed or damaged cord may impair the electronic components and may cause electrical shock.

WARNING: DO NOT begin a surgical procedure if the battery charge indicator light is in the last two yellow or red zones. The power console may be plugged into an AC outlet during surgery so as to maintain adequate charge for single or multiple procedures.

CAUTION: Always check battery for adequate charge prior to setup. Allow sufficient time for charging if required. The light bar on the power console will indicate the amount of charge available in the battery. **True charge indication is obtained when the instrument is not running (static).**

NOTE: Connecting the console to the AC supply during surgery will allow for maintaining or increasing the battery charge.

HANDPIECE ACTIVATION (FORWARD/REVERSE OSCILLATE)

Turn power console on. Select the desired mode, forward/reverse or oscillate, on the power console mode selector. (Press selector button.) See Figure 12.

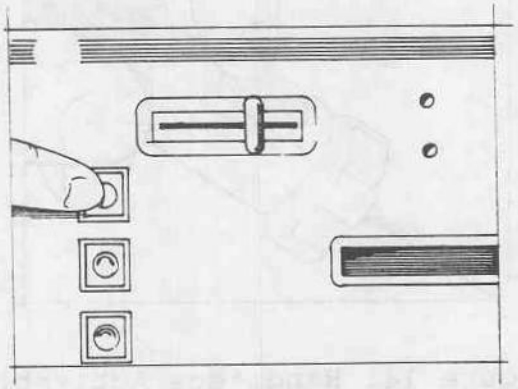


Figure 12. Mode Selection

Select desired handpiece and press corresponding button to activate. See Figure 13.

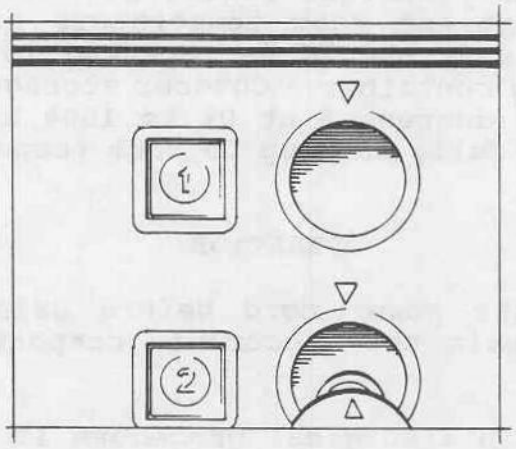


Figure 13. Handpiece Selection

Apply pressure to the finger operated control pad. See Figure 14.

(A) Press control pad once and the instrument will activate.

(B) Press again and the instrument will stop. Cutter speed will operate at a pre-selected speed determined by the position of the power console variable speed control device. The speed may be adjusted while the instrument is running.

(C) The instrument may be reversed by pressing the "reverse" pad. See Figure 15. Manual oscillate mode may be performed in this way.

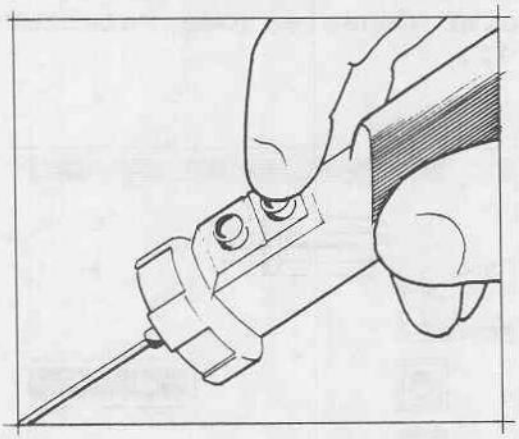


Figure 14. Handpiece Activation

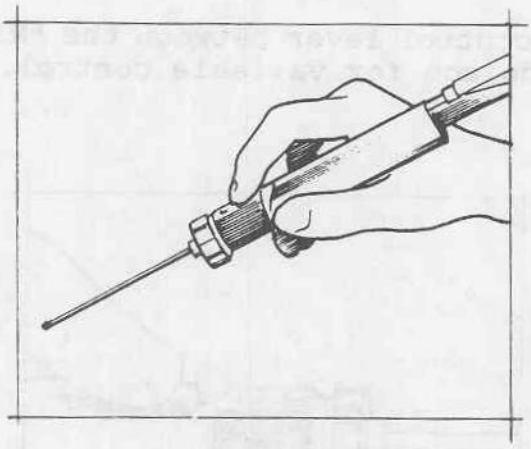


Figure 15. Direction Selection

The various APS functions and their controls are listed in Table 2.

TABLE 2. OPERATING MODES

DESIRED FUNCTION	CHARGER MODE SELECTOR	CONTROL PAD POSITION
FORWARD	FWD/REV	FRONT PAD
REVERSE		REAR PAD
OSCILLATE	OSCILLATE	OSCILLATE
OSCILLATE	OSCILLATE	OSCILLATE

ASPIRATION CONTROL

Set the aspiration control lever between the "Minimum" or "Maximum" setting on the handpiece for variable control. See Figure 16.

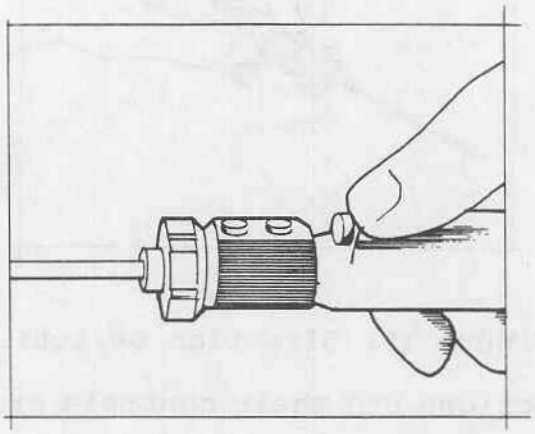


Figure 16. Aspiration Control

CUTTER WINDOW POSITIONING

Push the window positioning collar forward to unlock it from the handpiece and turn the collar in either direction to desired position. See Figure 17.

The positioning collar will automatically slide back into locked position.

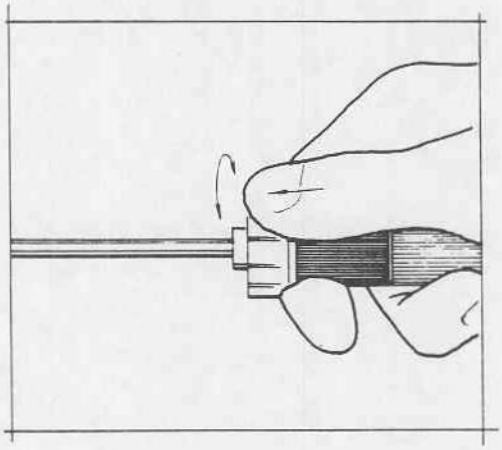


Figure 17. Cutter Window Position Control

CUTTER OR BUR REMOVAL

Grasp the cutter or bur in one hand and the APS handpiece in the other. Pull the two components apart. See Figure 18.

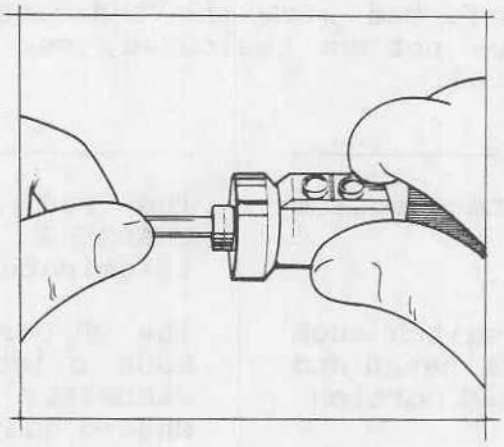


Figure 18. Cutter/Bur Removal

FOOT CONTROL CONNECTION

Insert foot control plug into corresponding receptacle on the console. See Figure 19. Press the blue foot control button above the receptacle. When the button illuminates, the foot pedal is activated and the fingertip controls on the handpiece no longer regulate the APS handpieces.

To use foot pedal, press the desired rotation indicated on the footpad; the instrument will respond accordingly. To reactivate fingertip controls, simply press the blue button on the console so that the illumination turns off.

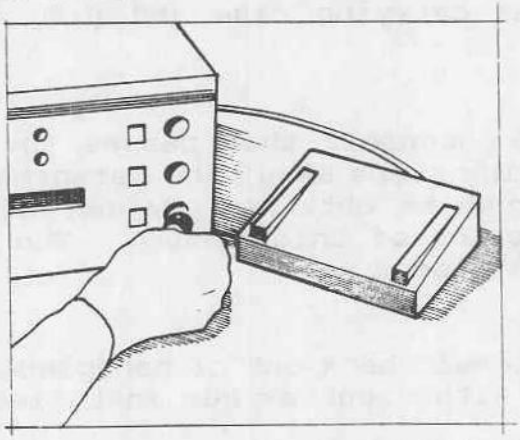


Figure 19. Foot Control Connection

OPERATIONAL CHECKOUT

POWER CONSOLE

Unpack the console from its carrying case. The console should be allowed to acclimate to room ambient temperature (minimum 60 degrees F) for 24 hours before operational checkout. The following steps should be performed with the indicated results. If the results obtained are not as indicated, see the troubleshooting sections of the manual.

STEP	RESULT
Plug the console into a source of 110V AC power.	The red AC ON and BATTERY CHARGING indicators should illuminate.
Depress the ON/OFF switch such that it becomes illuminated and locks in the depressed portion.	The ON/OFF switch, the ROTATE MODE selector switch and the HANDPIECE 1 SELECTOR switches should illuminate.
Depress the ROTATE/OSCILLATE MODE selector switch.	The ROTATE MODE selector switch should not be illuminated and the ROTATE/OSCILLATE MODE selector switch should be illuminated.
Depress the ROTATE MODE selector switch.	The ROTATE/OSCILLATE MODE selector switch should not be illuminated. The ROTATE MODE selector switch should be illuminated.

HANDPIECES

The following operational checkout steps apply to both the HIGH SPEED APS handpiece and the LOW SPEED APS handpiece. Unpack the handpieces from the carrying case and plug them into the power console.

An operational power console that passes the above tests is required. The following steps should be performed with the indicated results. If the results obtained are not as indicated, see the troubleshooting section of this manual. The steps should be repeated for each handpiece.

CAUTION: Operational check out of handpieces should not be performed with a cutter/bur installed.

STEP	RESULT
Turn the console ON and place it in the ROTATE mode (ROTATE MODE selector switch illuminated). Depress the HANDPIECE selector switch corresponding to the handpiece to be tested. Depress the front (closest to the cutter receptacle) finger operated control pad once.	The handpiece should operate in a clockwise direction (direction may be determined by looking into the cutter receptacle).

STEP	RESULT
Depress the front finger operated control pad again.	The handpiece should stop operating.
Depress the rear finger operated control pad once.	The handpiece should operate in a counterclockwise motion.
Depress the rear finger operated control pad again.	The handpiece should stop operating.
Depress the HANDPIECE 2 selector switch.	The HANDPIECE 1 selector switch should not be illuminated. The HANDPIECE 2 selector switch should be illuminated.
Depress the HANDPIECE 1 selector switch.	The HANDPIECE 2 selector switch should not be illuminated. The HANDPIECE 1 selector switch should be illuminated.
Depress the FOOTSWITCH selector switch such that it locks in the depressed position.	The FOOTSWITCH selector switch should illuminate.
Depress the FOOTSWITCH selector switch such that it unlocks from the depressed position.	The FOOTSWITCH selector switch should not be illuminated.

COMPLETE SYSTEM

The following operational check out will test the unit as a complete system. The preceding two checkouts (CONSOLE and HANDPIECES) must have been successfully completed before performing these steps. The following steps should be performed with the indicated results. If the results are not as indicated, see the troubleshooting section of this manual.

STEP	RESULT
With the console in the ON position enter the ROTATE/OSCILLATE mode by depressing the ROTATE/OSCILLATE MODE selector switch.	The ROTATE/OSCILLATE mode switch should illuminate.
Depress the front finger operated control pad once.	The handpiece should operate in a clockwise directions.
Depress the front finger operated control pad again.	The handpiece should stop operating.
Depress the rear finger operated control pad once.	The handpiece should operate in an oscillatory fashion with approximately 1 second of clockwise motion followed by approximately 1 second of counterclockwise motion then returning to a clockwise direction in a repeating fashion.
Depress the rear finger operated control pad again.	The handpiece should stop operating.
Depress the front finger operated control pad once.	The handpiece should operate in a clockwise direction.
Move the SPEED CONTROL on the front of the console to the left.	The speed of the handpiece should decrease.
Move the SPEED CONTROL on the front of the console to the right.	The speed of the handpiece should increase.
Depress the front finger operated control pad once.	The handpiece should stop operating.

FOOTSWITCH

The following operational check out will test the footswitch control of the APS. The previous three checkouts (CONSOLE, HANDPIECE, and SYSTEM) must be successfully completed before performing these steps. The following steps should be performed with the indicated results. If the results are not as indicated, see the troubleshooting section of this manual. Before beginning, depress the ROTATE MODE selector switch.

STEP	RESULT
Plug the footswitch into the APS console. Depress the FOOTSWITCH SELECTOR switch.	The FOOTSWITCH SELECTOR switch should latch in the depressed position and illuminate.
Depress, in turn, the front and then the back finger operated control pad on the active handpiece.	The handpiece should not operate.
Depress and hold the left treadle of the footswitch.	The handpiece should operate in a clockwise direction.
Release the left treadle of the footswitch.	The handpiece should stop operating.
Depress and hold the right treadle of the footswitch.	The handpiece should operate in a counterclockwise direction.
Release the right treadle of the footswitch.	The handpiece should stop operating.

INSPECTION

This section explains the detailed visual inspection that should be given to the APS console and handpieces whenever they are serviced.

CONSOLE

The APS console should be clean of dirt, dust, blood, saline, or other foreign matter that could accumulate during storage or use in surgery. The power cord should not be frayed, cracked or broken. The switches on the front of the unit should operate as explained in the Operational Checkout section of this manual. For cleaning instructions, please see the Operations Manual.

When plugged in and turned on, the APS should display green bars in the BATTERY CHARGE LEVEL INDICATOR. The unit should not be stored unless it is fully charged to this level. Charging instructions may be found in the Operations Manual.

HANDPIECE

The handpiece should be clean of dirt, dust, blood, saline, or other foreign matter that could accumulate during storage or use in surgery. The handpiece should be clean on the inside as well as the outside. Cleaning instructions may be found in the Operations Manual. The handpiece cord and connector should not be frayed, cracked, or cut. The control pads should not be cut or damaged.

FOOTSWITCH

The footswitch should be clean of dirt, dust, blood, saline, or other foreign matter that could accumulate during storage or use in surgery. The plastic cover over the footswitch may be removed for inspection. The cover should not be cut, cracked, or split. The footswitch cord should not be frayed, cracked, or cut.

REPAIR

CONSOLE TROUBLESHOOTING

The following is a troubleshooting guide for the APS console. It should be used in conjunction with the BLOCK DIAGRAM (Figure 8) and the DISASSEMBLY/ASSEMBLY sections of this manual to correct problems.

SYMPTOM: Power does not come on

PROBABLE CAUSE	REPAIR
Bad fuse in Power Entry Module.	Check and replace 250mA fuses.
A.C. connector assembly not connected to charger.	Reconnect A.C. Connector Assembly (15-3092-032-00) to Charger (22-6316-000-00)
Bad A.C. Board assembly.	Remove and replace A.C. Board Assembly (15-3902-290-00)
Bad charger.	Remove and replace Charger (22-6316-000-00)

SYMPTOM: "Charging" light not lighting when battery should be charging.

PROBABLE CAUSE	REPAIR
Open connection from charger to BACC wire harness, or from BACC harness to battery.	Remove and check continuity of BACC Harness Assembly (15-3922-300-00), repair open.
Bad relay or bridge on A.C. board.	Remove and replace A.C. Board Assembly (15-3092-290-00)

SYMPTOM: Far right most L.E.D. on charge level indicators not lighting, and battery has had sufficient time to charge.

PROBABLE CAUSE	REPAIR
Bad battery.	Remove, test, and replace Battery (22-6320-000-00) as required.

SYMPTOM: Erratic or incorrect light display of LED charge indicators.

PROBABLE CAUSE	REPAIR
Faulty control board.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Speed control not functioning.

PROBABLE CAUSE	REPAIR
Bad speed control assembly.	Remove and replace Speed Control Assembly (15-3922-034-00).
Faulty control board.	Remove, test and repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: One of the front panel switches not lighting.

PROBABLE CAUSE	REPAIR
Blown bulb.	Remove and replace bulb (22-26954-00-00).
Faulty switch.	Check bulb contacts and adjust if out. Also check soldering of switch. Re-solder and/or replace as required. Use 22-6289-001-00 or 22-6289-003-00 as required.

SYMPTOM: Handpiece doesn't run and console indicators are functioning properly.

PROBABLE CAUSE	REPAIR
Open connection in handpiece harness assembly. Possible ground.	Remove and test continuity of Harness Assembly (15-3922-301-00) and repair connection.
Faulty control board.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Handpiece runs in one direction only.

PROBABLE CAUSE	REPAIR
Open connection in handpiece harness assembly.	Remove and test continuity of Harness Assembly (15-3922-301-00) and repair connection.
Faulty control board. Possible bad direction logic.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Handpiece doesn't oscillate.

PROBABLE CAUSE	REPAIR
Open connection in handpiece harness assembly.	Remove and test continuity of Harness Assembly (15-3922-301-00) and repair connection.
Faulty control board. Possible faulty forward/reverse timer, or direction logic.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Handpiece runs slow with charge indicators showing full charge.

PROBABLE CAUSE	REPAIR
Faulty control board. Possible bad (Q1) or (U16).	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Excessively fast discharge time of charged battery in console.

PROBABLE CAUSE	REPAIR
Bad battery.	Remove, test and replace Battery (22-6320-000-00) as necessary.
Faulty control board.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Handpiece runs when trigger is depressed, but will not stop when button is depressed a second time.

PROBABLE CAUSE	REPAIR
Faulty control board. Possibly wrong resistor at (R56), or bad direction logic.	Remove, test, repair or replace Control Board (15-3922-296-00) as required.

SYMPTOM: Handpiece doesn't function properly when using foot switch.

PROBABLE CAUSE	REPAIR
Faulty switch.	Check and replace Footswitch (00-5039-028-00) as required.
Faulty footswitch wire harness assembly.	Remove and replace Footswitch Wire Harness Assembly (15-3922-302-00) as required.

HANDPIECE

The following is a troubleshooting guide for the APS Handpieces. it should be used in conjunction with the DISASSEMBLY/ASSEMBLY section of this manual to correct problems.

SYMPTOM: Handpiece doesn't run.

PROBABLE CAUSE	REPAIR
Open motor wire.	Re-solder wire.
Bad instrument cord assy.	Replace Instrument Cord Assy. (15-3926-028-00).
Bad motor assembly.	Replace Motor Assembly (15-3930-001-00 for High Speed Handpiece; 15-3901-001-00) for Low Speed Handpiece.
Bad trigger assembly.	Replace Trigger Assembly (15-3901-005-00).

SYMPTOM: Handpiece runs but cutter doesn't rotate.

PROBABLE CAUSE	REPAIR
Motor adaptor loose on motor assembly output shaft.	Tighten Set Screw (22-6469-000-00) on Motor Drive Adaptor.
Gear damage in motor assembly.	Replace Motor Assembly (15-3930-001-00 for High Speed Handpiece; 15-3901-001-00 for Low Speed Handpiece).

SYMPTOM: Unit runs without depressing trigger.

PROBABLE CAUSE	REPAIR
Shorted trigger assembly.	Replace Trigger Assembly (15-3901-005-00).

SYMPTOM: Unit runs in one direction only.

PROBABLE CAUSE	REPAIR
Open wire in trigger assembly.	Replace Trigger Assembly (15-3901-005-00).
Open wire in instrument cord assy. or from cord to trigger assy.	Reconnect open wire if exposed, or replace Instrument Cord Assy. (15-3926-028-00).

SYMPTOM: Unit runs slow.

PROBABLE CAUSE	REPAIR
Worn, or contaminated motor assembly.	Replace Motor Assembly (15-3930-001-00 for High Speed Handpiece; 15-3901-001-00 for Low Speed Handpiece).

SYMPTOM: Instrument cord to housing.

PROBABLE CAUSE	REPAIR
Worn instrument cord assy.	Replace Instrument Cord Assy. (15-3926-028-00).
Exposed cord wire, or wires, in handpiece.	Re-insulate wire at exposed joint or replace as required.

SYMPTOM: Unit will not accept .343 plug gauge.

PROBABLE CAUSE	REPAIR
Burrs or foreign matter in nose assembly.	Carefully deburr, and clean, or replace Nose Assembly (15-3901-010-00) as required.

SYMPTOM: Collar on nose assembly will not retract properly.

PROBABLE CAUSE	REPAIR
Foreign matter inside nose assembly.	Remove and repair Nose Assembly (15-3901-010-00).

DISASSEMBLY/ASSEMBLY

CONSOLE

These instructions should be used in conjunction with FIGURES 20 thru 23. Follow the steps as required for repair after referencing the CONSOLE TROUBLESHOOTING section of this manual.

Remove Power Supply Cover (22-16699-00-00) by removing the (4) Screws (22-6329-000-00).

Cut off Wire Tie - red and black (22-6377-001-00, 22-6377-002-00).

Disconnect leads from battery.

Remove Safety Screws (22-6323-000-00) from Electronics Cover (22-16698-00-00) using T-5039-7.

Remove Battery (22-6320-000-00) by removing two Screws (22-6321-000-00) and the Battery Bracket (22-15925-00-00).

Remove Control Board (15-3922-296-00) by disconnecting the BACC Harness Assembly (15-3922-300-00), Handpiece Harness Assembly (15-3922-301-00), Speed Control Assembly (15-3922-034-00) and (4) Kep Nuts (22-6313-000-00).

Remove the A.C. Board Assembly (15-3902-290-00) by disconnecting the A.C. Tub Assembly (15-3922-031-00) leads, A.C. Connector Assembly (15-3902-032-00) leads from Barrier Strip (22-6296-000-00) on the A.C. board, and BACC Harness Assembly (15-3902-300-00). Then remove the (4) Kep Nuts (22-6313-000-00) that hold the board to the chassis (Note: The Shield (22-15922-00-00) should be inspected at this point for any damage).

Remove the BACC Harness Assembly (15-3922-300-00) from the A.C. Charger (22-6316-000-00).

Remove the A.C. Charger (22-6316-000-00) by removing the (4) Screws (22-6317-000-00).

Remove the Speed Control Assembly (15-3922-034-00) by removing (2) Pot Clips (22-15863-00-00).

Remove the A.C. Tub Assembly (15-3922-031-00) by removing the (2) Screws (22-6744-000-00).

Remove the Handpiece Harness Assemblies (15-3922-301-00) by removing the (3) Kep Nuts (22-6328-000-00) on each.

Remove the Foot Control Wire Harness Assembly (15-3922-302-00) by removing the (2) Retainers (22-16765-00-00).

HANDPIECES

These instructions should be used in conjunction with FIGURES 24 thru 26. Follow the steps as required after referencing the HANDPIECE TROUBLESHOOTING section of this manual.

Disassembly of Instrument:

Place unit in T-5039-88 and secure in vise.

Remove Instrument Cord Assembly (15-3901-028-00).

Use T-5039-22 to remove End Cap Retainer (22-15913-00-00).

Remove end cap to expose wire connections, then de-solder cord.

Remove Nose Assembly (15-3901-010-00).

Use T-5039-46A & B or T-5039-46C and a strap wrench to remove nose assembly.

Remove Trigger Assembly (15-3901-005-00).

Using an X-Acto knife, cut through rubber boot where it mates with Housing (22-16200-00-00), then remove trigger assembly.

Remove Switch Mount Nut (22-15918-00-00).

Use T-5039-22 to remove switch mount nut.

Remove Switch Mount (22-15917-00-00).

Remove Motor Assembly (15-3930-001-00).

Use T-5039-88 to secure unit while removing motor assembly with T-5039-50.

Repair and Test of Components or Sub-assemblies:

Test forward and reverse speed of Motor Assembly (15-3930-001-00).

Test Motor (15-3930-001-00) using an adjustable power supply set at 11.4 volts - 2 amps. Check to assure forward and reverse speeds of at least 750 RPM.

Repair of Nose Assembly (15-3901-010-00).

Remove Front Cover (22-15961-00-00) by removing both Pins (22-15963-00-00) using a 1/16 drift punch.

With assembly apart, clean contaminated components.

Replace any damaged or worn components and re-assemble per AP 15-3901-010-00.

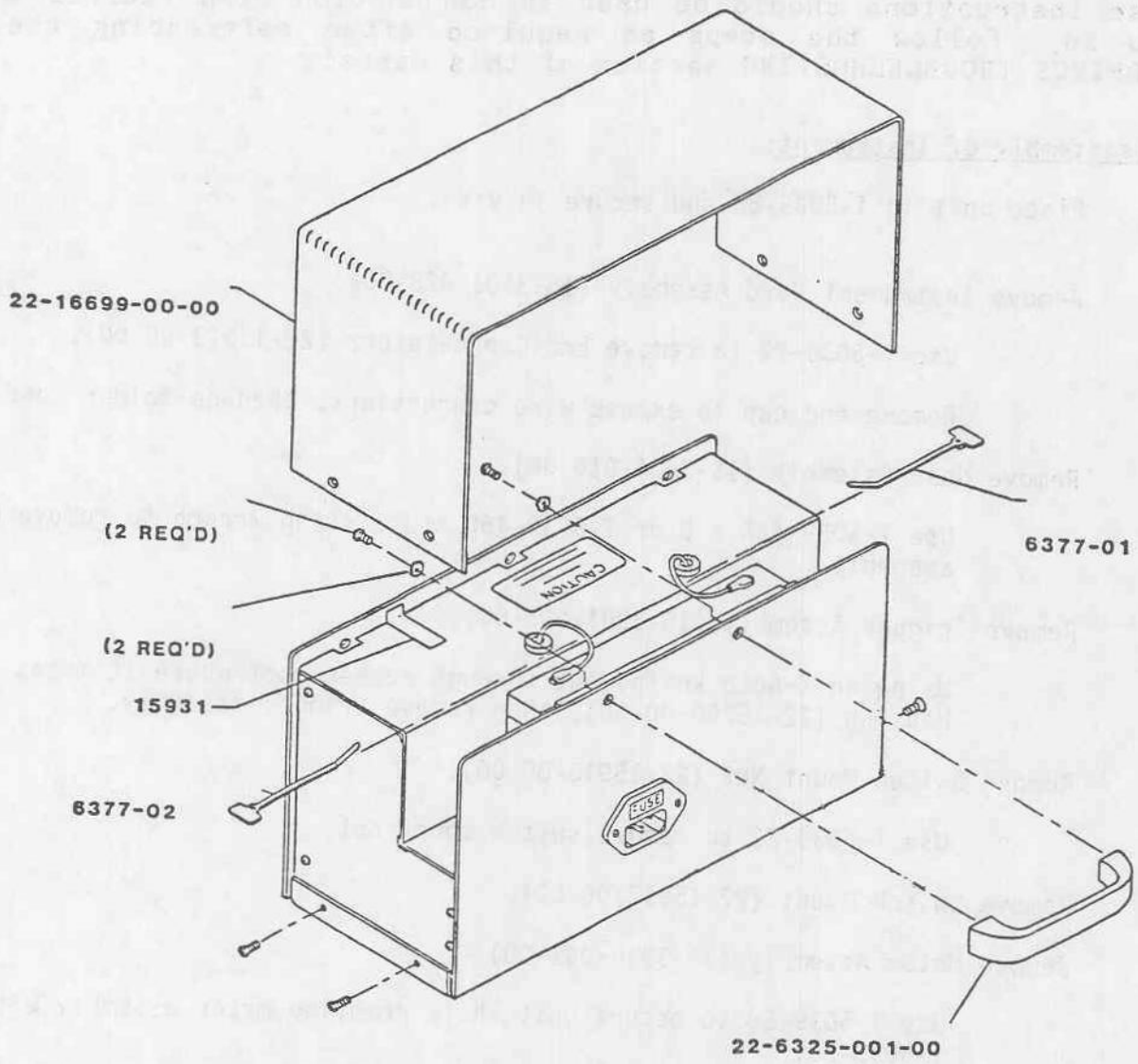


Figure 20. Console Top Cover Disassembly/Assembly

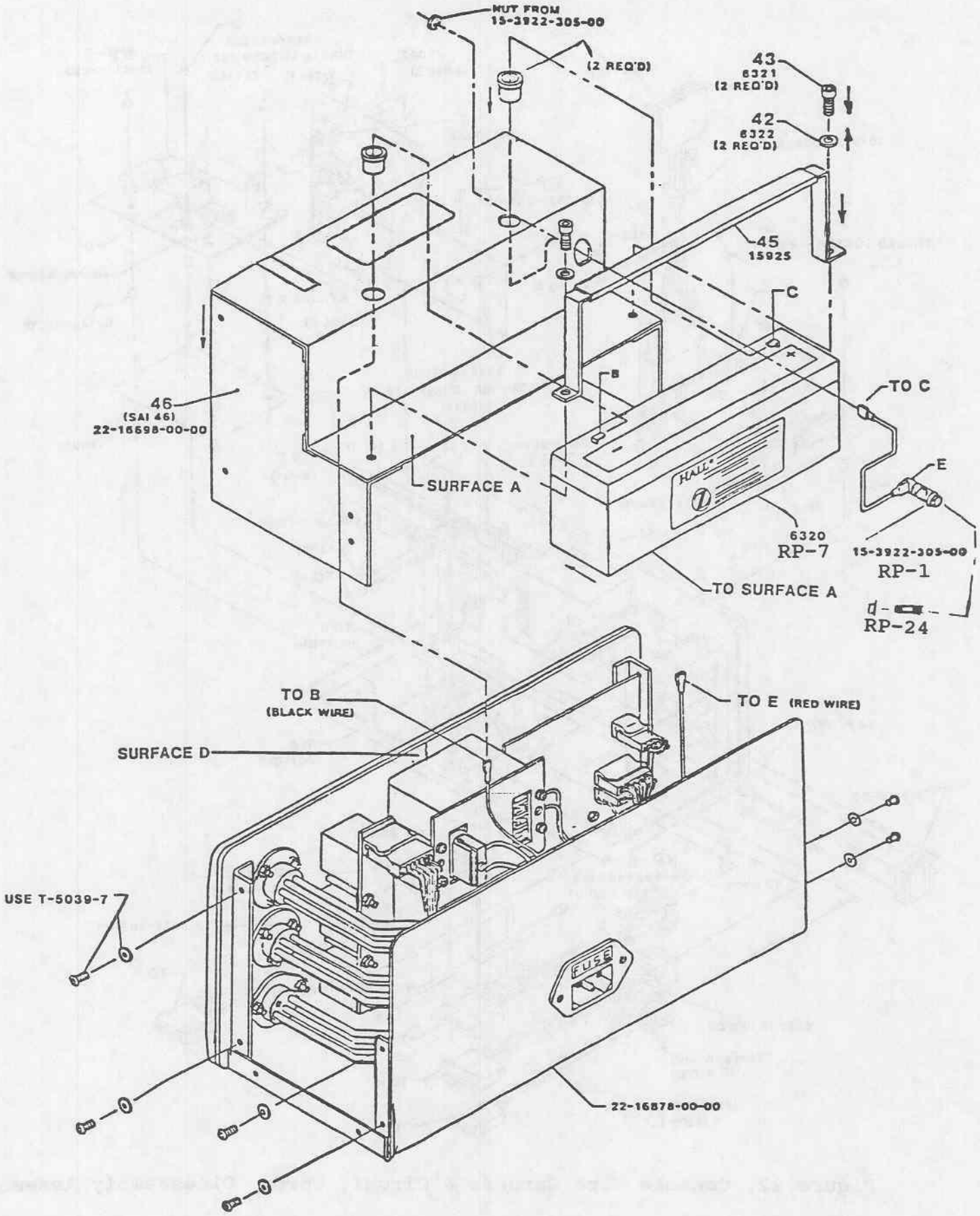


Figure 21. Console Battery & Inner Cover Disassembly/Assembly

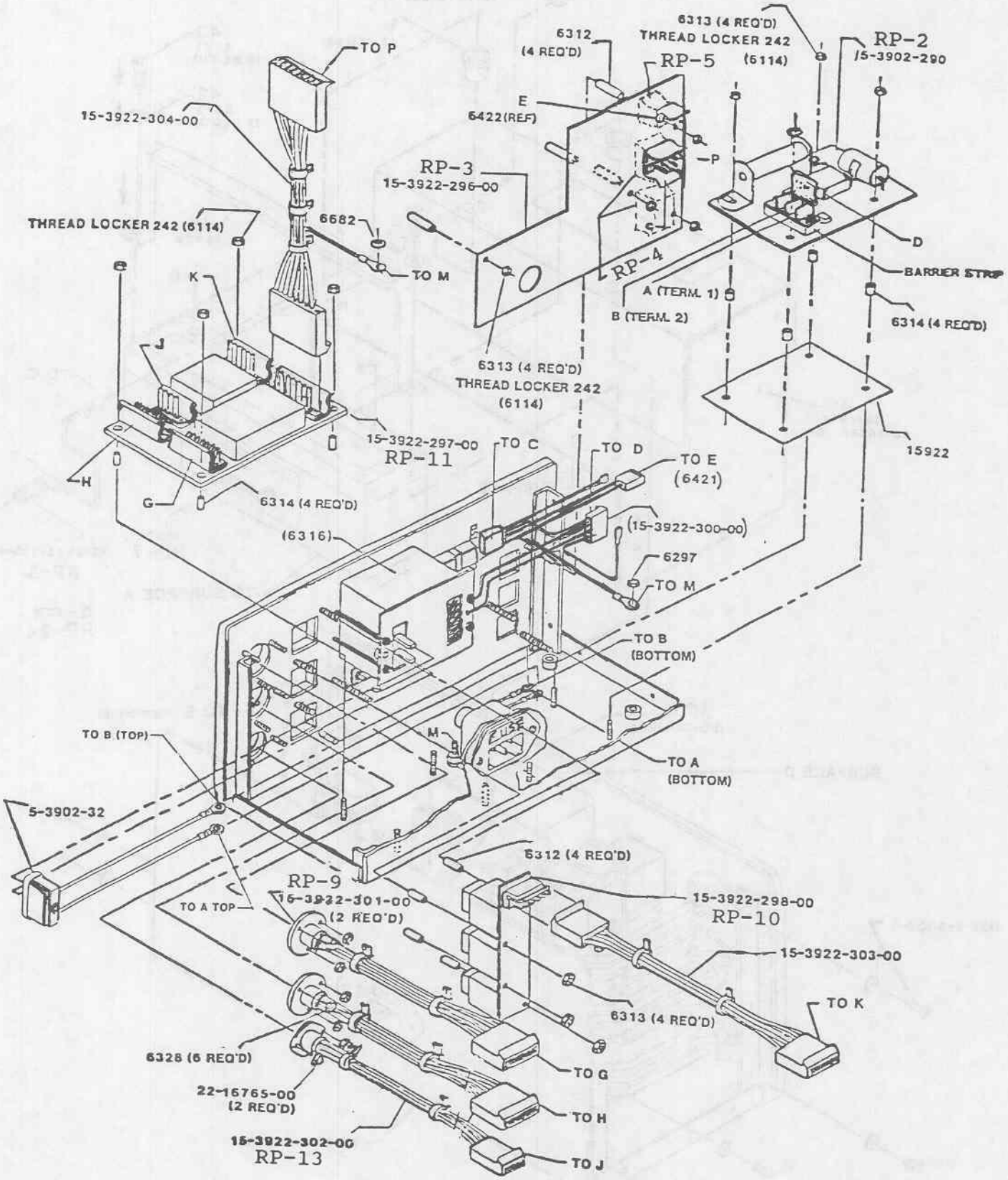


Figure 22. Console Wire Harness & Circuit Cards Disassembly/Assembly

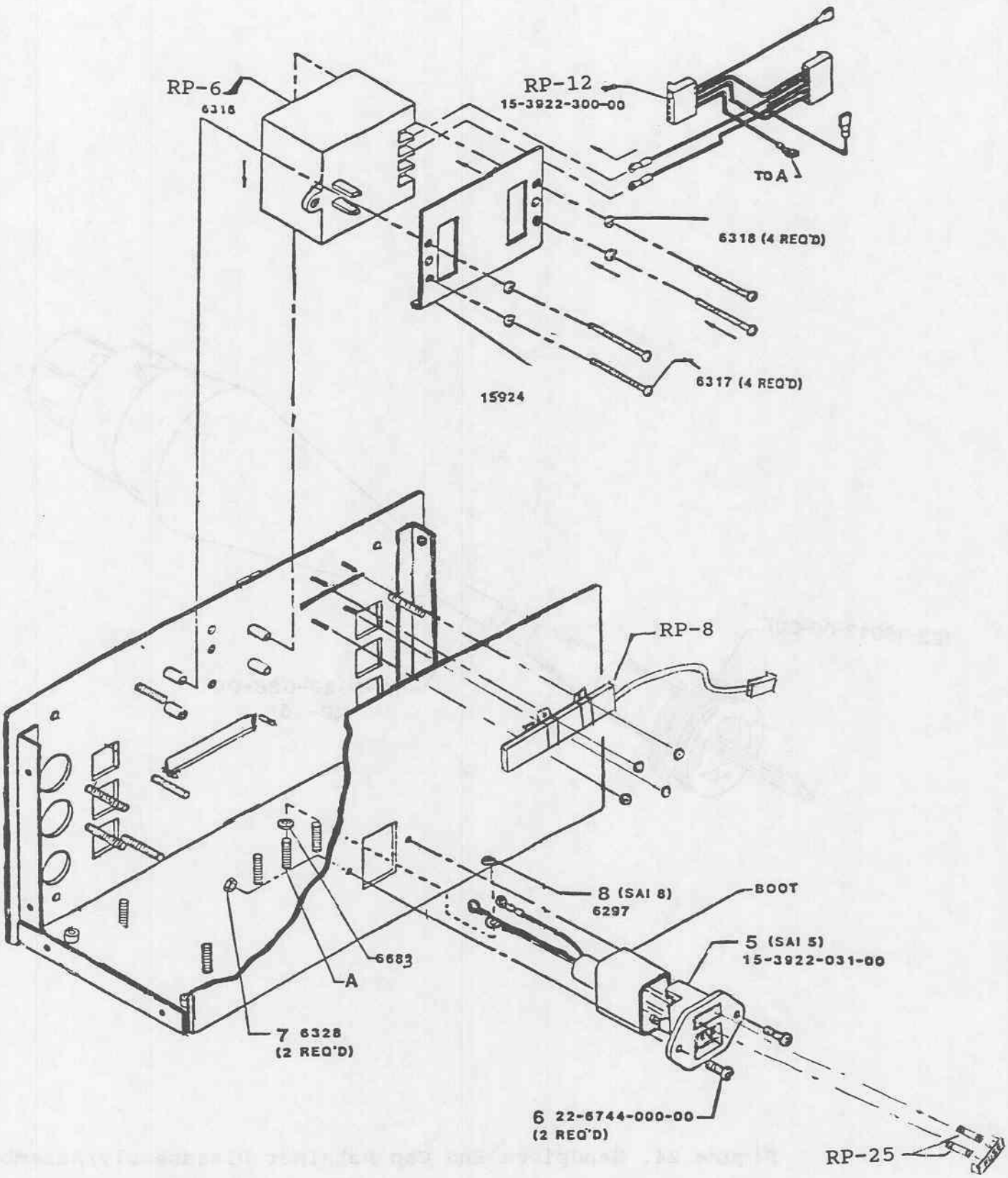


Figure 23. Console Battery Charger Disassembly/Assembly

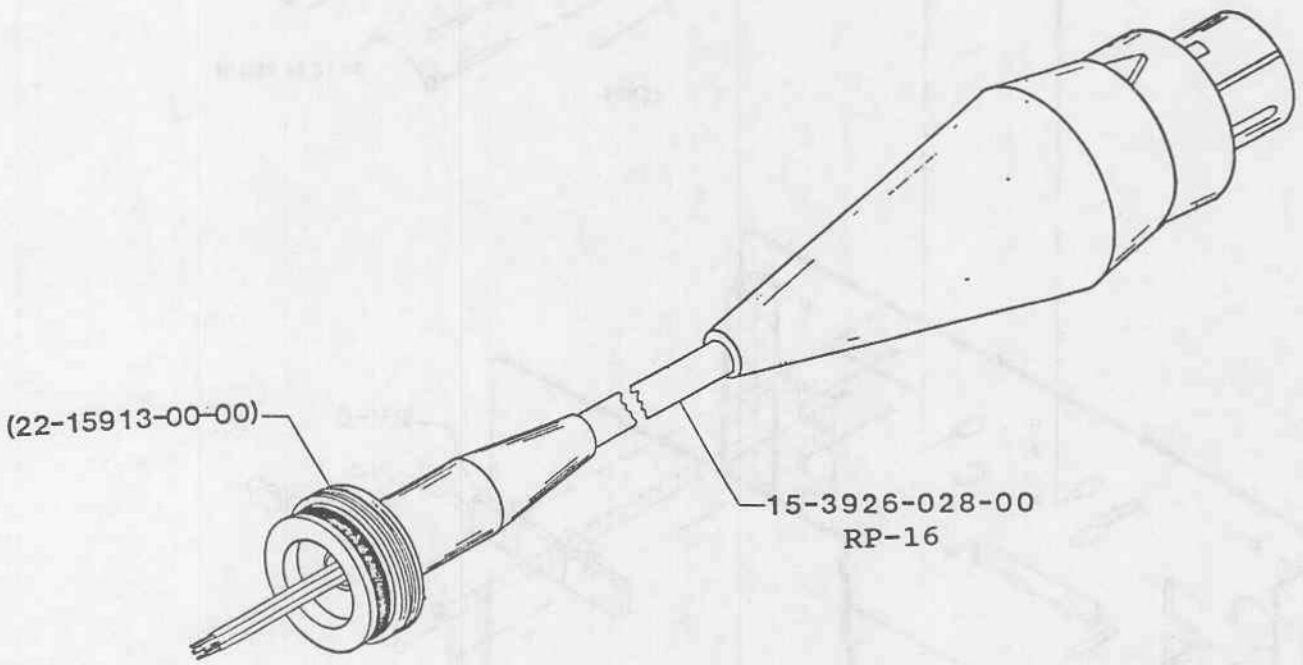


Figure 24. Handpiece End Cap Retainer Disassembly/Assembly

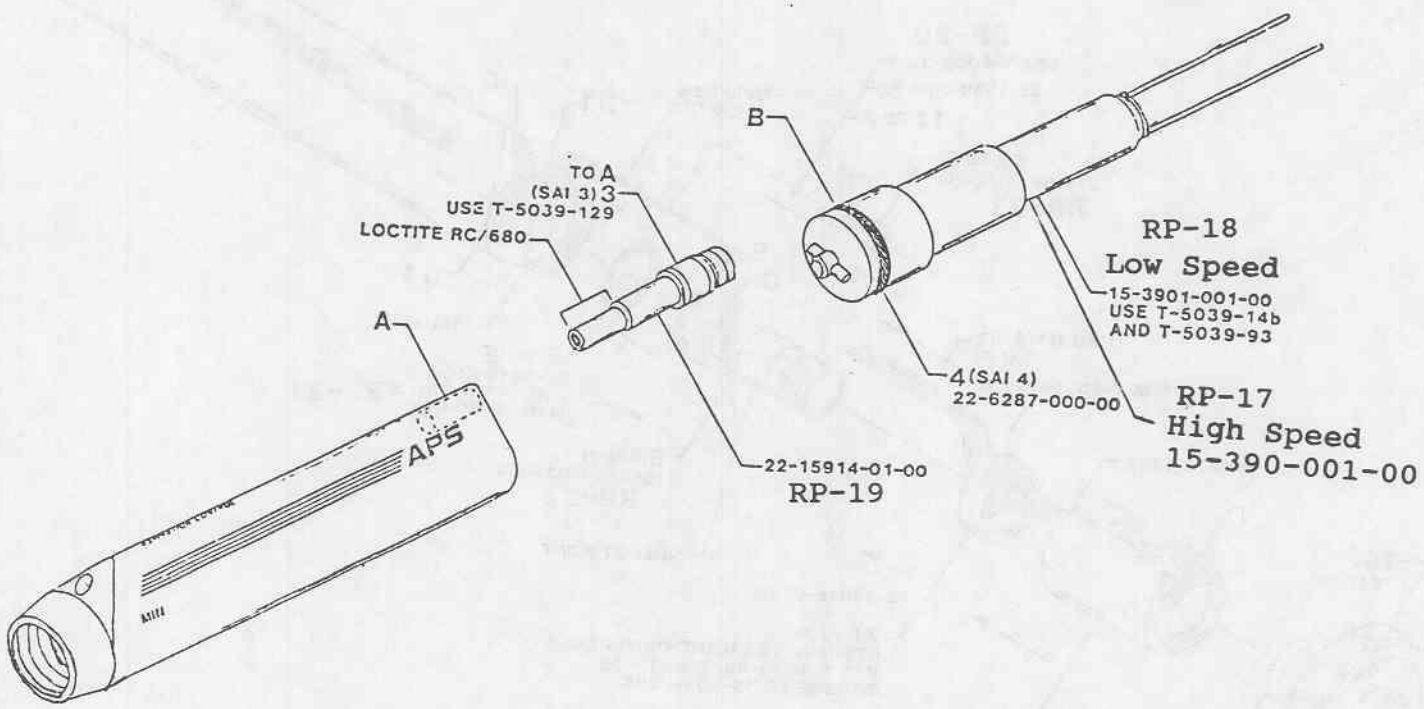


Figure 25. Handpiece Motor & Aspiration Control Disassembly/Assembly

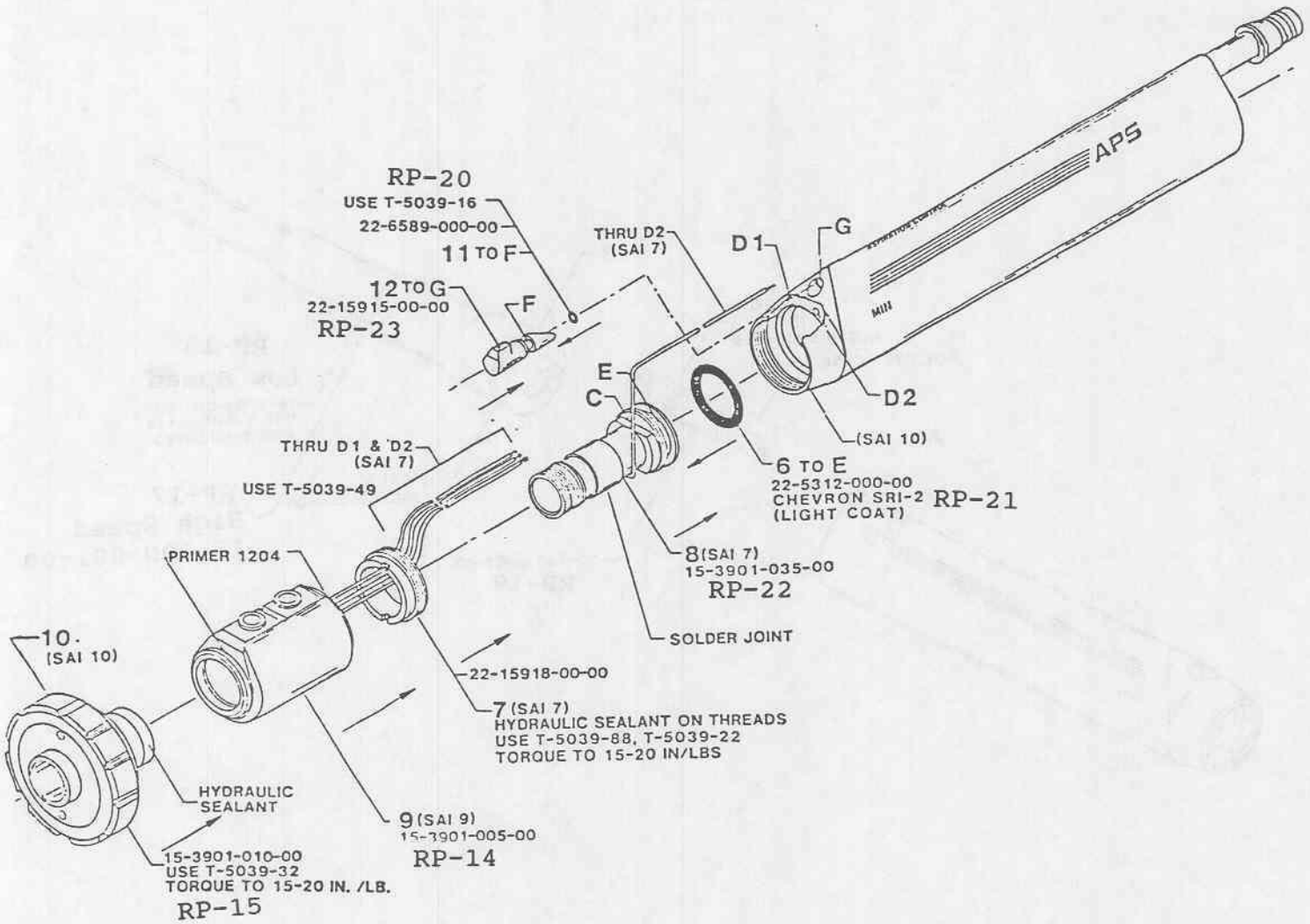


Figure 26. Handpiece Trigger & Nosepiece Disassembly/Assembly

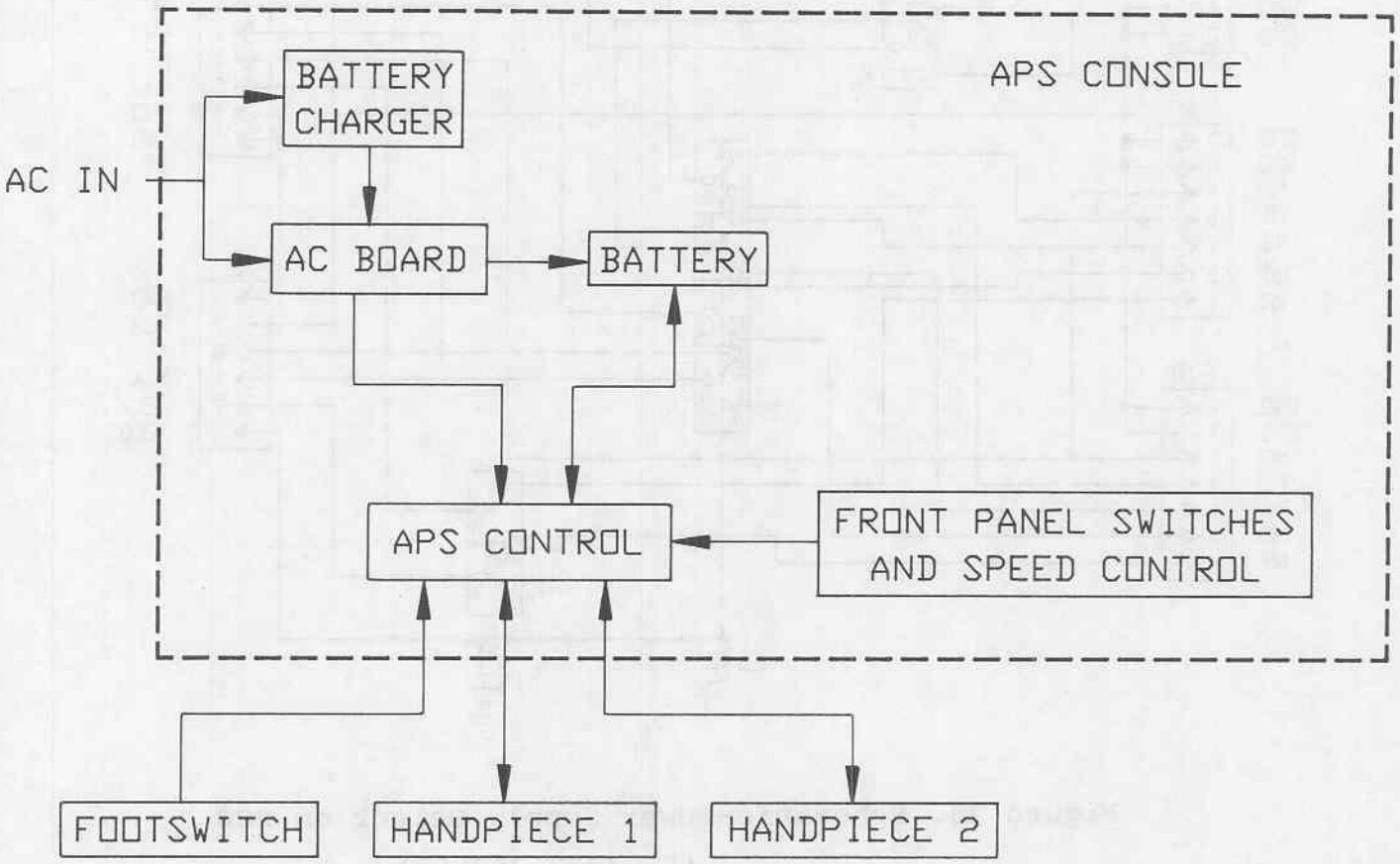


Figure 27. Block Diagram

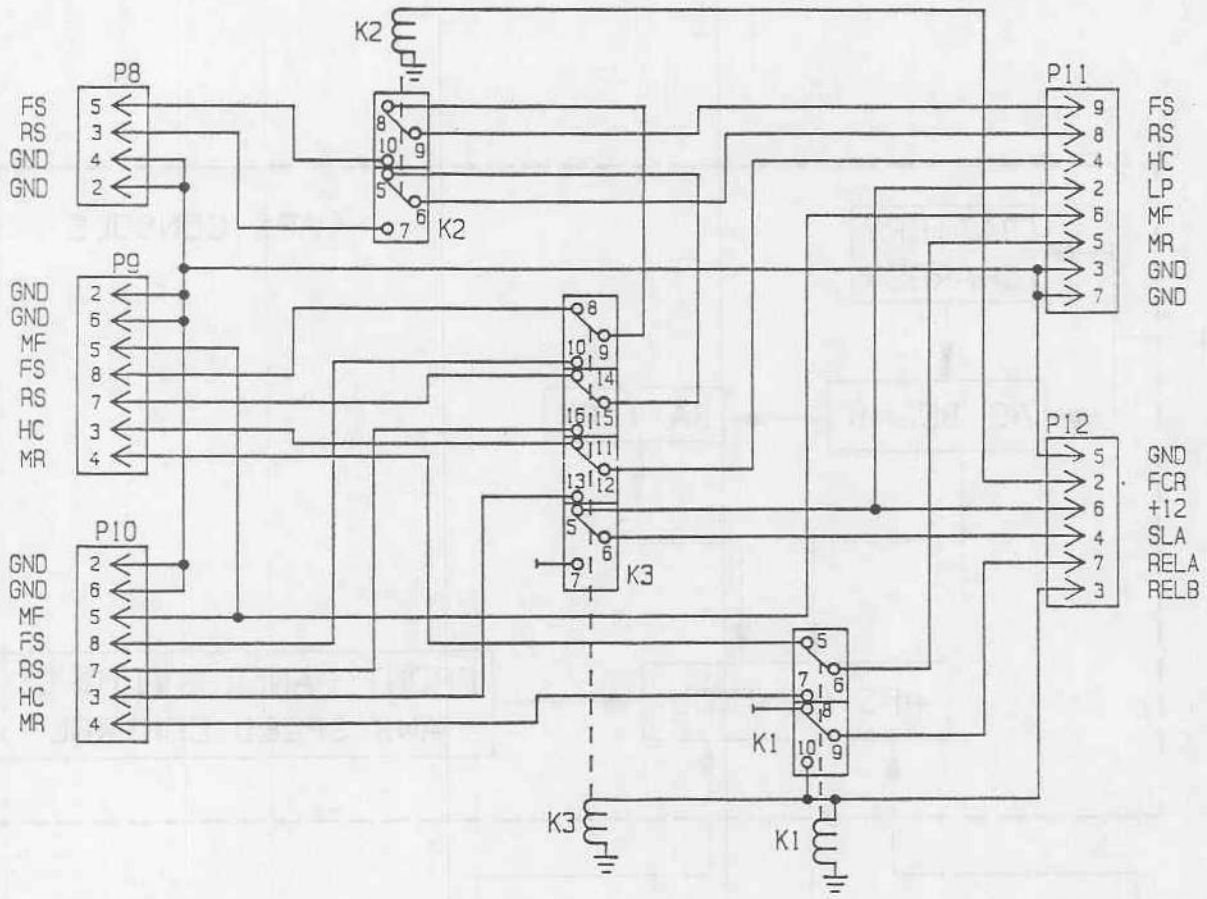


Figure 28. Schematic-Power Supply Selection PCB

(15-3922-297-00)

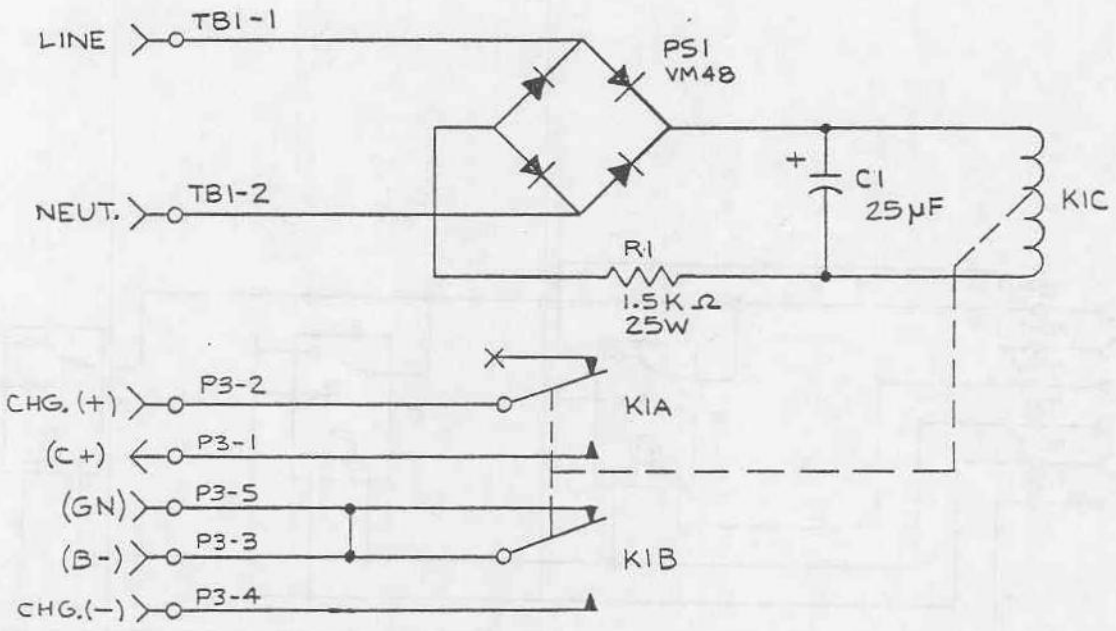


Figure 29. Schematic-Power Supply, AC PCB
(15-3902-290-00)

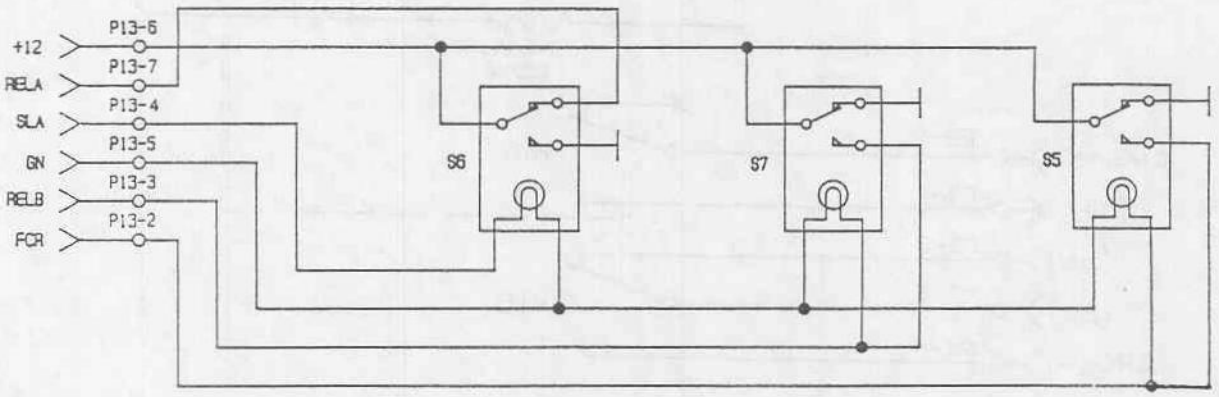


Figure 30. Schematic-Power Supply Switch PCB
(15-3922-298-00)

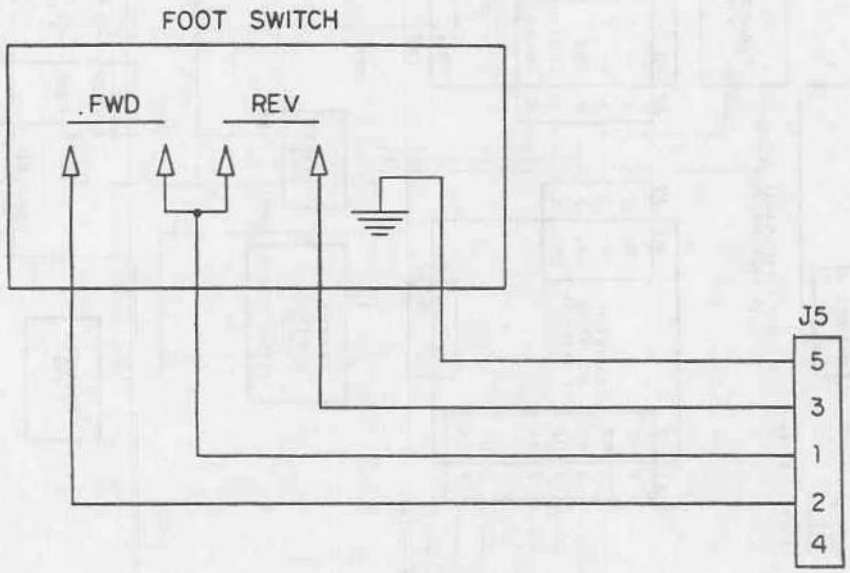


Figure 31. Schematic-Footswitch & Cord

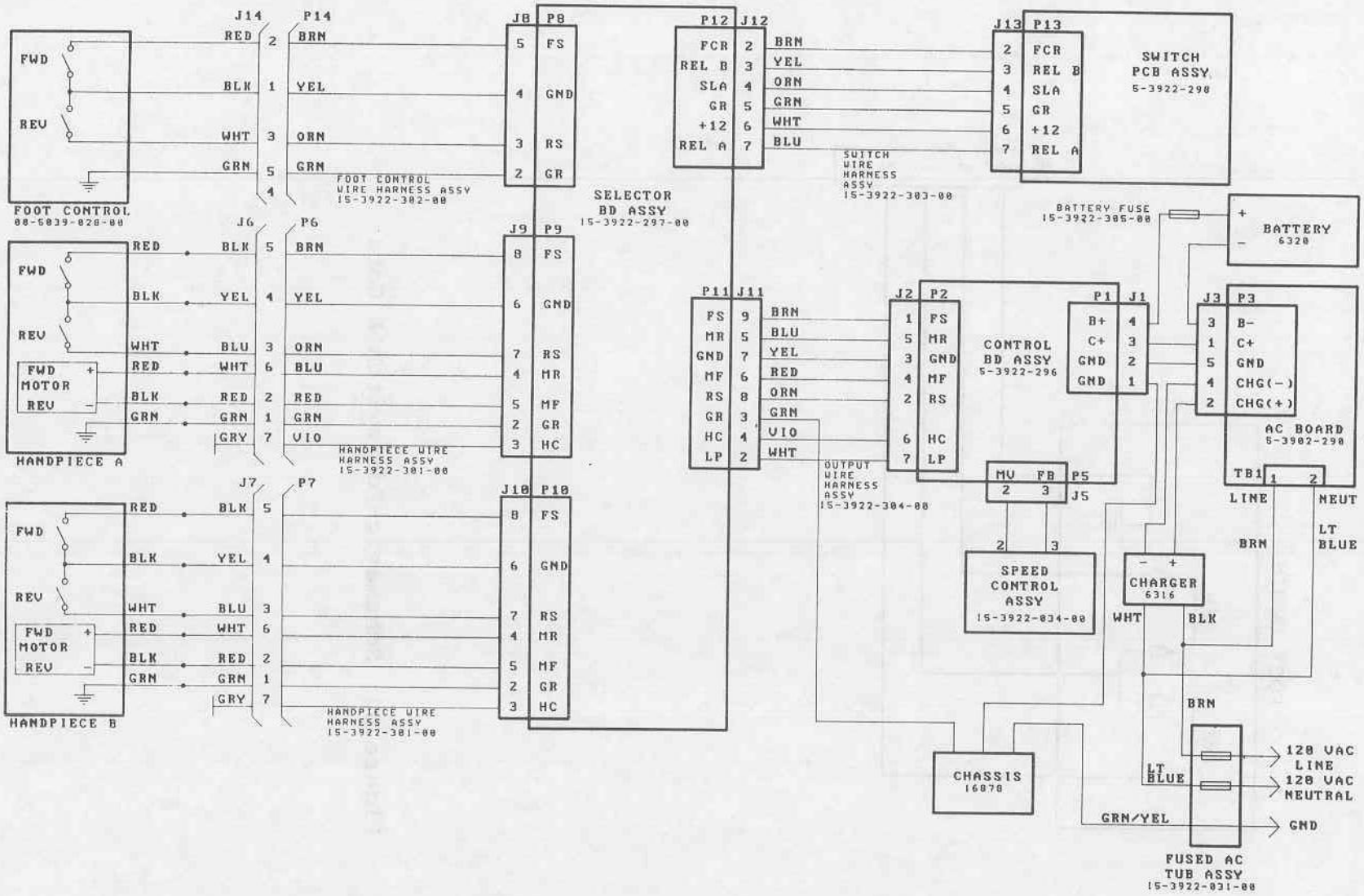


Figure 32. Wiring Diagram

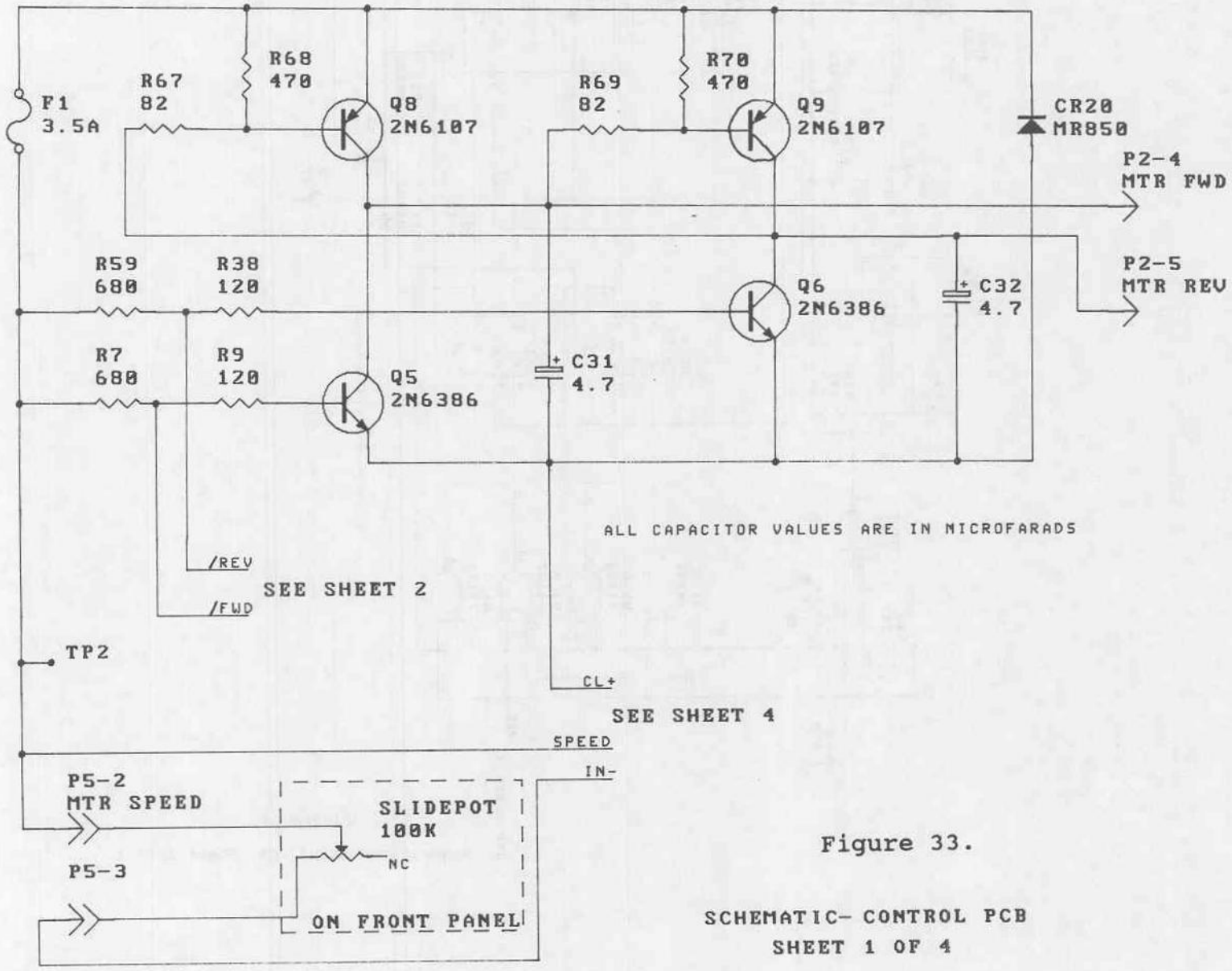


Figure 33.

SCHEMATIC- CONTROL PCB
SHEET 1 OF 4

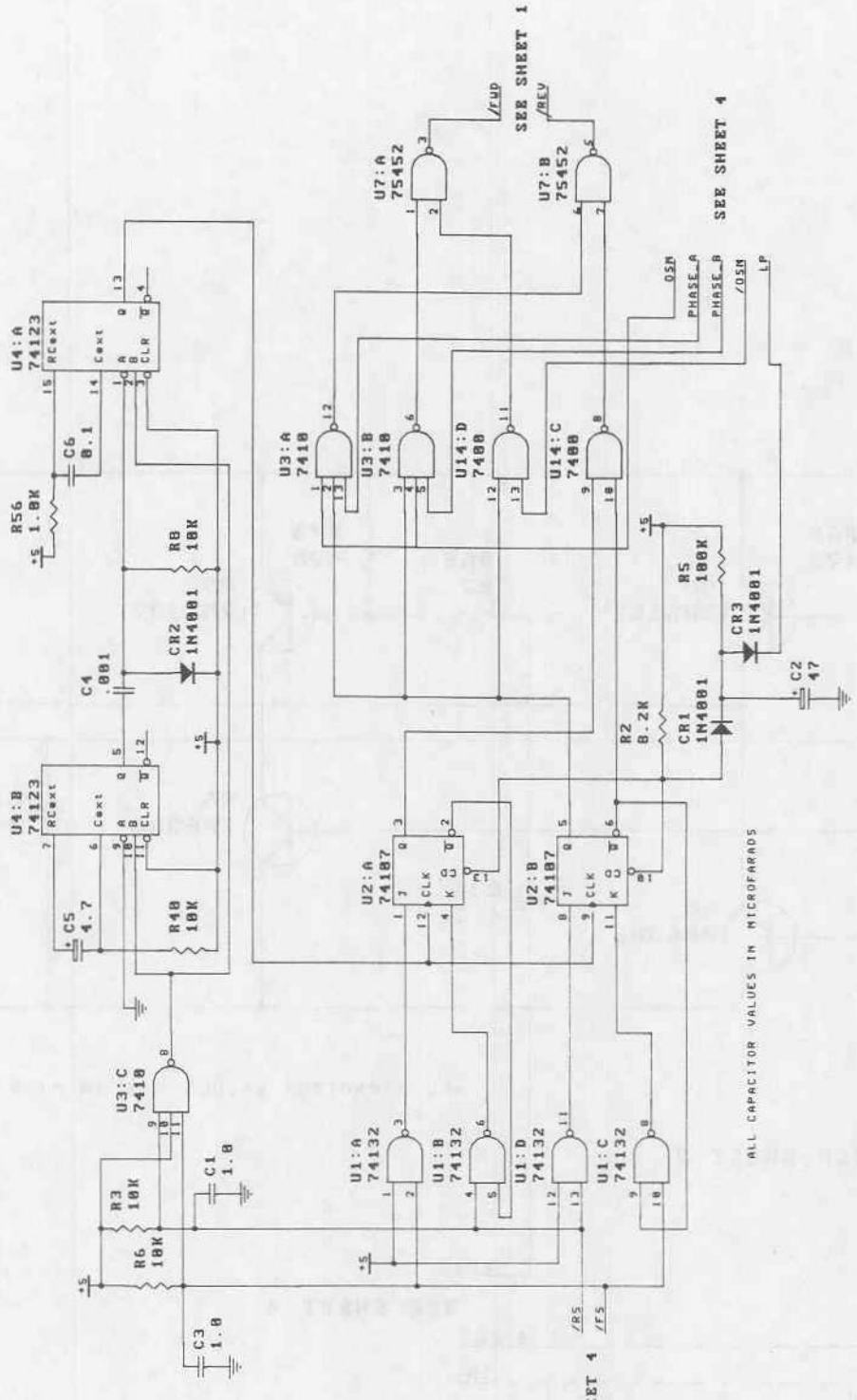


Figure 34.

Schematic-Control PCB, Sheet 2 of 4

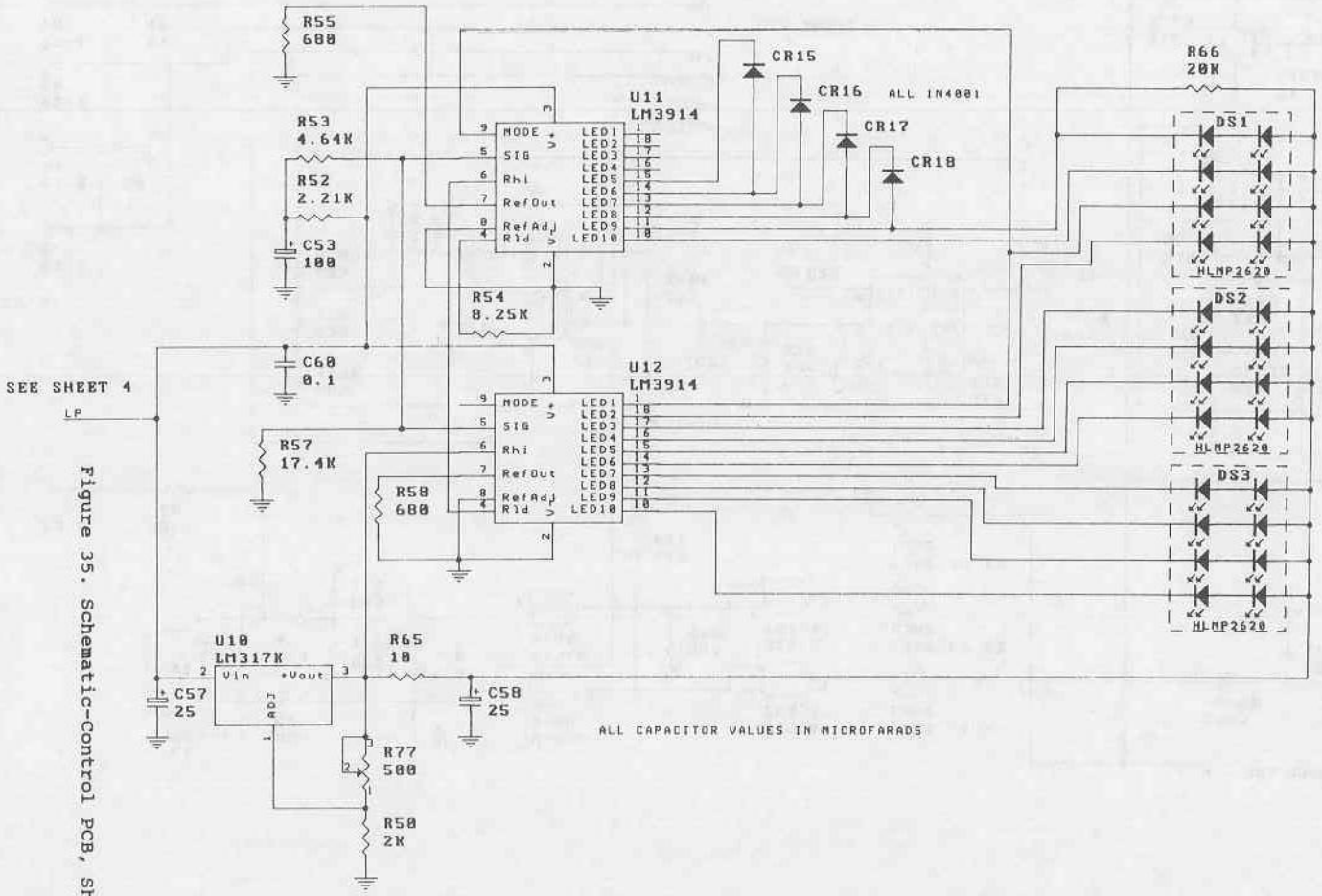


Figure 35. Schematic-Control PCB, Sheet 3 of 4

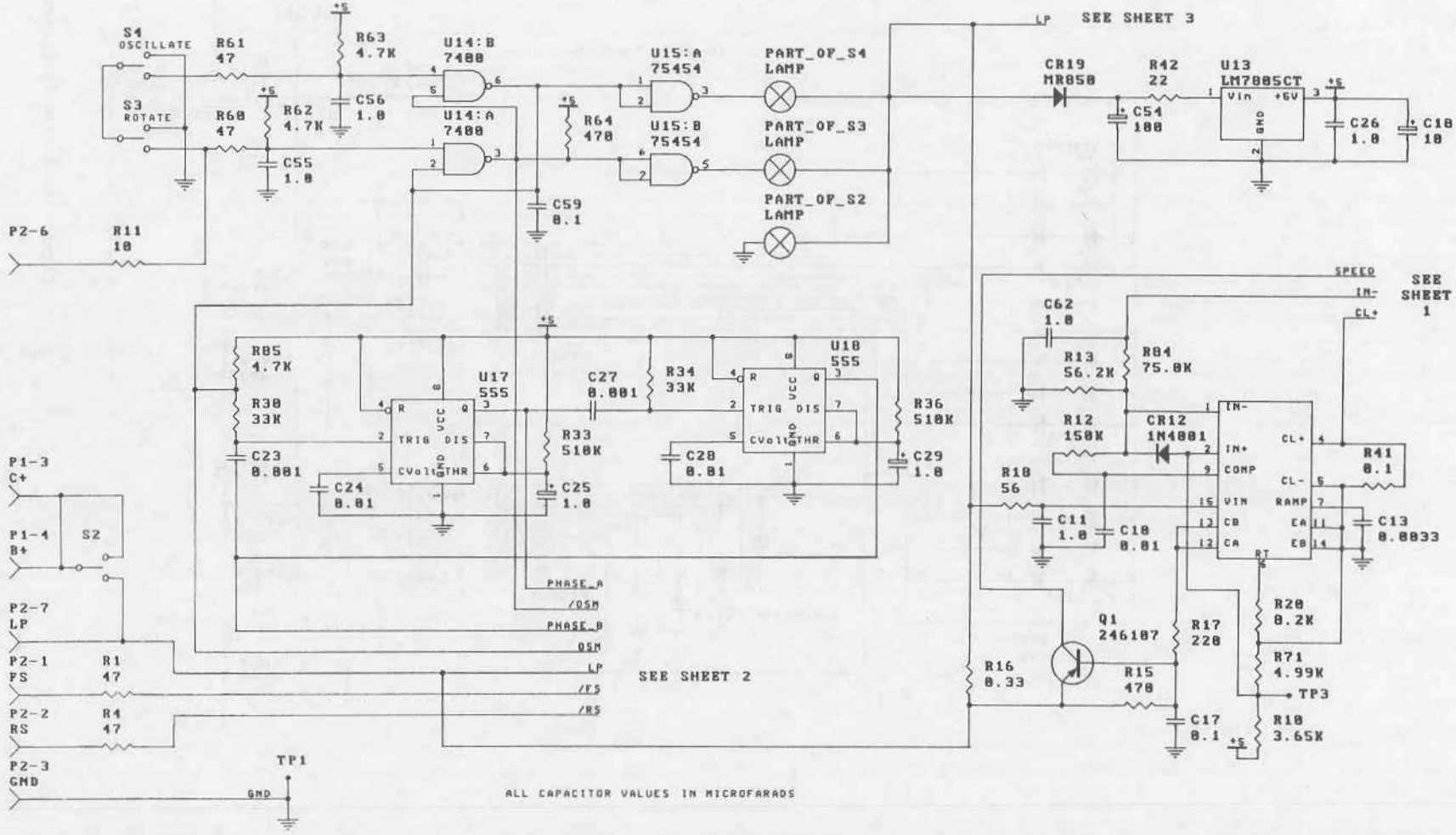


Figure 36. Schematic-Control PCB, Sheet 4 of 4

FUNCTIONAL DESCRIPTION

Please refer to Figure 27 for the block diagram of the unit.

AC IN
Input power is provided to the system via an IEC plug receptacle and provides fusing of input power. The receptacle connections are as shown in figure 32 - Wiring Diagram as - FUSED AC TUB ASSY 15-3922-031. AC power is distributed to the BATTERY CHARGER and AC BOARD.

BATTERY CHARGER
The Battery Charger is a standard commercial unit designed to charge a 12 Volt lead - acid storage battery. The Battery Charger output is connected to the AC BOARD. The Charger has LED's to display Charger power On and Charger in Fast Charge mode. The LED's are visible from the front panel. Connections are as shown in Figure 32 - Wiring Diagram - CHARGER 6316.

AC BOARD
The AC Board is used to disconnect the Battery Charger from the Battery when the Charger is not energized and also distributes power from the battery to the APS CONTROL Bd Assy. Connections are as shown in Figure 32 - Wiring Diagram - AC BOARD 5-3982-290 and Schematic - Power Supply, AC PCB of Figure 29.

BATTERY
The Battery is a standard 12 Volt gel cell lead acid battery. Battery positive (+) voltage is distributed to the APS CONTROL thru a fused receptacle located inside the console and is accessible when the cover is removed. The Battery negative (-) is connected to the AC BOARD. Connections are as shown in Figure 32 - Wiring Diagram - BATTERY 6320.

APS CONTROL
The APS Control consists of three (3) printed circuit boards, CONTROL BD ASSY, SWITCH PCB ASSY, and the SELECTOR BD ASSY. Power and control are thru these boards.

CONTROL BD ASSY
The Control Board Assy. controls handpiece motor power, direction, mode, and speed. The Board monitors and displays battery charge and is the connection point for the ON/OFF, ROTATE, and ROTATE/OSCILLATE front panel switches. The Handpiece speed control SPEED CONTROL ASSY 15-3922-034-00 is connected via this board. Connections are as shown in Figure 32 - Wiring Diagram - CONTROL BD ASSY 5-3922-296 and in Figures 33 thru 36, Schematic - Control PCB.

SPEED CONTROL ASSY
The speed control assembly consists of a linear slide resistor and interconnecting cable which connects to the Control Board. Connections are as shown in Figure 32 - Wiring Diagram - SPEED CONTROL ASSY 15-3922-34-00.

SWITCH PCB ASSY
The Switch Control Assy provides electrical connections and mounting for Handpiece 1, 2 and Foot Control mode switches controlled from the front panel. Connections are as shown in Figure 32 - Wiring Diagram - SWITCH PCB ASSY 5-3922-298 and Schematic - Power Supply Switch PCB of figure 30.

SELECTOR BOARD ASSY
The Selector Board Assy provides electrical connections and mounting for the three (3) relays required to select Handpiece 1 or 2 and the foot control option. The Board is the connection point for the Handpiece connectors J6, J7, Foot control connector J14, and interfaces with the SWITCH PCB ASSY, and CONTROL BD ASSY. Connections are as shown in Figure 32 - Wiring Diagram - SELECTOR BD ASSY 15-3922-297-00 and Schematic - Power Supply Selection PCB figure 28.

HANDPIECE 1 (A)
The Handpiece 1 can be either a High or Low speed unit. The electrical construction is same. Either Handpiece consists of a small brush type motor and two (2) momentary contact switches to control operation of the unit. The Handpiece has a permanently attached cord and plug. The plug can connect to Handpiece 1 or Handpiece 2. Connections are as shown in Figure 32 - Wiring Diagram - HANDPIECE A.

HANDPIECE 2 (B)
Operation is identical to that above for HANDPIECE 1 (A). Connections are as shown in Figure 32 - Wiring Diagram - HANDPIECE B.

FOOTSWITCH
The Foot Switch Consists of two (2) momentary contact switches and connect to the console through a permanently attached cord and plug, J14. Connections are as shown in Figure 32 - Wiring Diagram - FOOT CONTROL and Figure 31 - Schematic - Footswitch and Cord.

CIRCUIT DESCRIPTION

The following are descriptions of the circuits present in the APS. The descriptions correspond to the figures (schematics) listed.

CIRCUIT SHOWN IN FIGURE 28

The Power Supply Selection PCB is attached to the lower right inside the unit and has reference designator for the relays and connectors marked on it. The schematic shows the relays in the non-activated (relay not switched) position. This is the position the relays are in when the unit is turned on. The relays connect the #1 handpiece to the control electronics to make it the active one. When the #2 handpiece control switch on the front of the unit is depressed, relays K1 and K3 switch and latch to disconnect handpiece #1 and connect handpiece #2.

Relay K2 switches and latches when the front panel footswitch control is depressed. This disconnects the forward and reverse switches from the handpieces and substitutes the footswitch controls. A second depression of the footswitch control places the relay back in its original non-activated state and returns the control of the handpieces to the handpiece switches.

CIRCUIT SHOWN IN FIGURE 29

This figure shows the Power Supply, AC PWB schematic. When AC power is present, bridge PS1, resistor R1 and capacitor C1 rectifies and filters the power to provide the coil voltage for relay K1. this relay controls whether the unit power is derived from the battery charger (AC power present) or just the battery (AC power absent).

CIRCUIT SHOWN IN FIGURE 30

This figures shows the Power Supply Switch PCB schematic. This PCB holds the handpiece #1 and #2 controls and the footswitch control onto the right front of the front panel. The switches are shown in there resting state (not depressed). The lights for each switch are shown at the bottom of each symbol. The operation of these switches controls the relays on the Power Supply, AC PWB as described above.

CIRCUIT SHOWN IN FIGURE 31

This schematic shows the footswitch with no pedals depressed.

CIRCUIT SHOWN IN FIGURE 32

This is a general wiring diagram showing the connectors and cabling that join the various PWB's and subassemblies.

CIRCUIT SHOWN IN FIGURE 33

This portion of the Control PCB schematic shows the drive electronics which provide the power to the APS handpieces. Transistors Q5, Q6, Q8, and Q9 are used as switches to control the connection and disconnection to the power and return lines for the handpiece motors.

When the /FWD signal is high, Q5 is on connecting P2-4 (MTR FWD) to the return path. Transistor Q9 is on connecting P2-5 (MTR REV) to the power source (SPEED). Transistors Q6 and Q8 are off. Fuse F1 and components CR20, C31, and C32 provide damping and protection of the power source.

The front panel slide switch which controls the speed of the handpiece is used as a variable resistance providing feedback to a pulse width modulating chip shown in Figure 17 and discussed later.

CIRCUIT SHOWN IN FIGURE 34

This portion of the Control PCB schematic shows the digital logic associated with the control switches and with the logic signals controlling handpiece rotation direction.

The resistors R3 and R6 are pull ups for the /RS (Reverse Switch) and /FS (Forward Switch) lines. The backslash (/) indicates the lines are low-active. Circuit U3:C, U4, and the associated passive components creates a single 25 nSec pulse at pin 13 of U4 whenever a forward or reverse switch is depressed on the footswitch or a handpiece. This pulse acts as a clock to the JK flip flops in U2. The /RS and /FS signals are also fed into U1 which in conjunction with U2 acts as a single depression debounce and latch for the forward or reverse switch depression.

Components R2, R5, CR1, CR3, and C2 provide power up and power down control of the clear lines in U2. The lines are low active. If signal LP (Line Power - the output of the battery charger) is present, then when the units power switch is turned on the clear lines immediately go high allowing U2 to correctly capture any command signals. When the unit is turned off, C2 allows the clear line to decay more slowly than the +5V line so that the outputs of U2 do not change state.

Components U3 and U14 accept the latched signals from U2 (representing switch activation) as well as the signals controlling oscillation (OSM, /OSM, PHASE_A, PHASE_B) and decodes these into the correct feeds for U7.

Component U7 provides the logic signals that control the polarity of the voltage being fed to the handpiece. When a handpiece is operating in the forward direction, the signal /FWD (U7 pin 3) is low and the signal /REV (U7 pin 5) is high. When the handpiece is operating in the reverse direction the signals are reversed. In the oscillate mode the signals alternate every 1.11 seconds.

CIRCUIT SHOWN IN FIGURE 35

This portion of the control PCB illustrates the circuitry that displays the status of the power supply. Component U10 and its associated resistors and capacitors provides the voltage needed to drive the bar displays. The power supply voltage is taken from signal LP. This signal is processed by dual LED display drivers U11 and U12. Resistors R52 and R53 provide a precision voltage divider to lower the voltage before being fed into U11 and U12. Capacitor C60 buffers the power supply voltage to prevent noise from rapidly changing the display. Resistors R55 and R58 control the brightness of the LED's. Diodes CR15 through CR18 are used as dummy loads to take the place of unused LED positions.

CIRCUIT SHOWN IN FIGURE 36

This section of the Control PCB schematic shows the logic that decodes the ROTATE/OSCILLATE modes and provides the signals that control them. It also shows the circuit that controls the handpiece voltage that determines rotational speed.

The front panel ROTATE (S3) and OSCILLATE (S4) switches feed U14 to toggle between the two operating modes. Components R60, R61, R62, R63, C55, and C56 act to pull up and filter the switch lines. When in the ROTATE mode, U14 pin 3 (/OSM) is high and U14 pin 6 (OSM) is low. These signal levels are reversed for the OSCILLATE mode. These signals also feed U15 and U17. Component U15 is used as a lamp driver to illuminate the switch that is active (ROTATE or OSCILLATE).

When U17 is active (in OSCILLATE mode) waveform A is present on signals PHASE_A and PHASE_B. These signals have opposite phases (when A is high, B is low). NOTE: Waveform A may be found in the Test Voltages section of this manual.

Component U16 and its associated components acts as a pulse width modulating circuit whose output is filtered by R15, R17 and C17 to drive Q1. The output of Q1 is the signal SPEED which is a variable voltage that is used as the power source for the switching transistors Q5, Q6, Q8 and Q9 shown in Figure 14.

TEST VOLTAGES

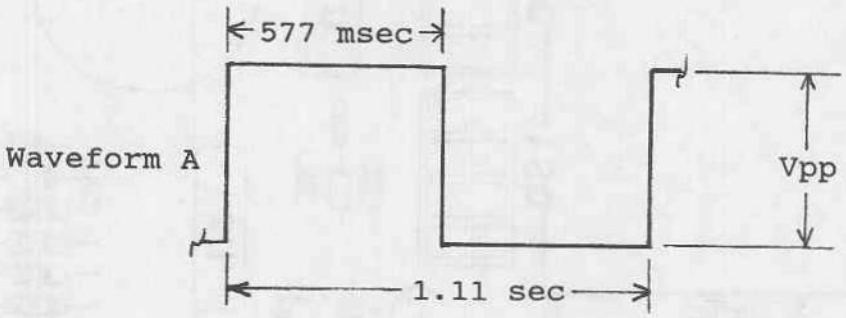
Test point Location	Operating Mode: Idle	Minimum Speed	Maximum Speed	Oscillate Min Speed	Oscillate Max Speed
U2 pin 3	0.1V	0.1V[5]	0.1V[5]	0.1V	0.1V
U2 pin 5	0.1V	3.7V[6]	3.7V[6]	3.7V	3.7V
U3 pin 12	3.8V	3.8V	3.8V	Waveform A Vpp = 3.8	Waveform A Vpp = 3.8
U14 pin 8	3.8V	3.8V[7]	3.8V[7]	3.8V	3.8V
U14 pin 11	3.8V	3.8V[8]	0.1V[8]	3.8V	3.8V
U3 pin 6	3.8V	3.8V	3.8V	Waveform A Vpp = 3.8	Waveform A Vpp = 3.8
U7 pin 3	0.1V	2.3V[6]	3.1V[6]	Waveform A Vpp = 2.3	Waveform A Vpp = 2.9
U7 pin 5	0.1V	2.3V[5]	3.1V[5]	Waveform A Vpp = 2.3	Waveform A Vpp = 2.9
P5-3 (IN-)	8.8V	7.6V	6.9V	7.5V	7.0V
TP2 (SPEED)	8.8V	7.6V	12.2V	7.5V	12.2V
P2-4(MTR FWD)	10.8V	7.7V[5]	12.1V[5]	Waveform A Vpp = 7.0	Waveform A Vpp = 11.5
P2-5(MTR REV)	10.8V	7.7V[6]	12.1V[6]	Waveform A Vpp = 7.0	Waveform A Vpp = 11.5
P2-7 (LP)	12.7V	12.7V	12.7V	12.7V	12.7V
U10 pin 3	8.9V	8.9V	8.9V	8.9V	8.9V
U14 pin 6	0.1V	0.1V	0.1V	4.9V	4.9V
U14 pin 3	4.9V	4.9V	4.9V	0.1V	0.1V
U17 pin 3	4.4V	4.4V	4.4V	Waveform A Vpp = 2.3V	Waveform A Vpp = 2.3V

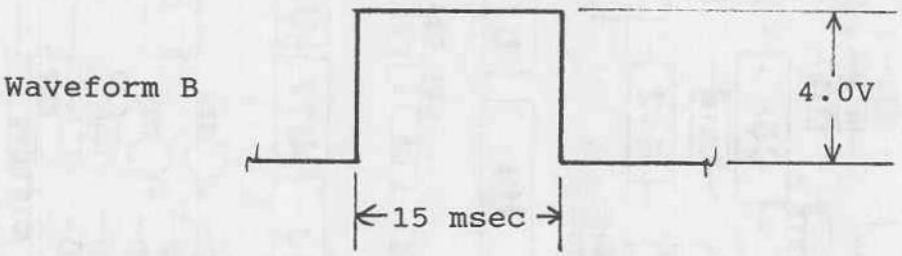
Continued on next page

Table 3

TEST VOLTAGES CONTINUED

Test point Location	Operating Modes: Idle	Minimum Speed	Maximum Speed	Oscillate Min Speed	Oscillate Max Speed
U18 pin 3	0.1V	0.1V	0.1V	Waveform A Vpp = 2.3	Waveform A Vpp = 2.3
TP3	2.8V	2.8V	2.8V	2.8V	2.8V
U4 pin 5	0.1V except when a switch is pressed on any handpiece or footswitch then a single pulse as in Waveform B				





NOTES:
1) TP1 is ground.
2) All Voltages are VDC unless otherwise specified.
3) See Figures 14 thru 17 for corresponding schematics.
4) All voltages are typical and tolerance is +/- 0.1 volts.
5) When handpiece is operating in the forward direction only.
6) When handpiece is operating in the reverse direction only.
7) When handpiece is operating in any mode except forward.
8) When handpiece is operating in any mode except reverse.

Table 3 Continued

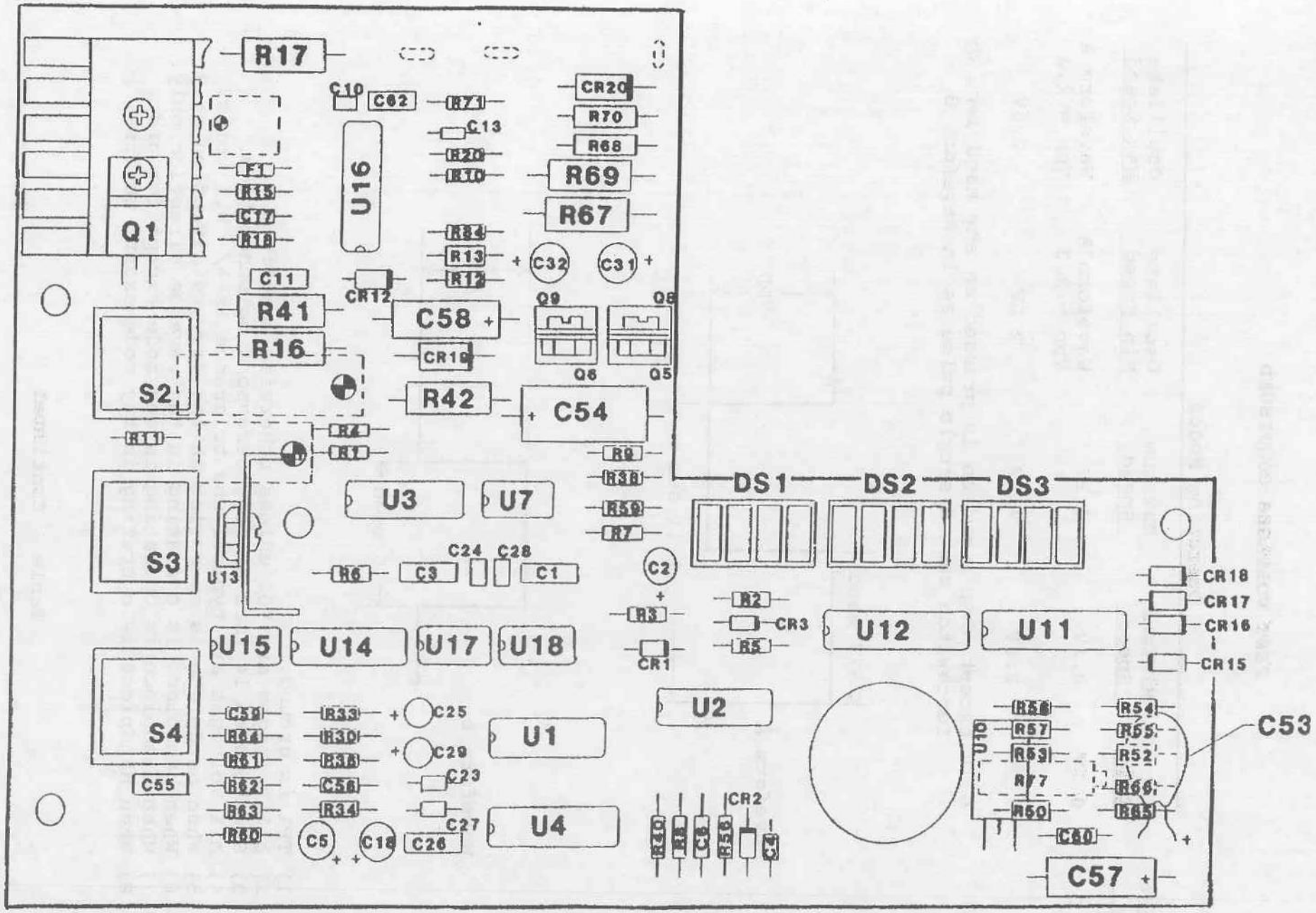


Figure 37
Compnent Layout - Control PCB

Parts List

Part Number	Part Name	Reference Designator	See Page
15-3922-305-00	Fuse Assy, Battery Pwr Supply	RP-1	31
15-3902-290-00	Bd Assy, AC Pwr Supply	RP-2	32
15-3922-296-00	Bd Assy, Cont Pwr Supply	RP-3	32
22-6289-001-00	Momentary Sw, P/W Contrl Bd	RP-4	32
22-6289-002-00	Alt Latch Sw, P.S. Contrl Bd	RP-5	32
22-6316-000-00	Charger, Battery Pwr Supply	RP-6	33
22-6320-000-00	Battery, 12V Lead Acid	RP-7	31
15-3922-034-00	Cont Assy, Pwr Supply Speed	RP-8	33
15-3922-301-00	Harness, Pwr Supply, H/Piece	RP-9	32
15-3922-298-00	Bd Assy, Pwr Supply Switch	RP-10	32
15-3922-297-00	Bd Assy, Pwr Supply Selector	RP-11	32
15-3922-300-00	Harness, Pwr Supply BACC Wire	RP-12	33
15-3922-302-00	Harness, Pwr Supply Foot Cntl	RP-13	32
15-3901-005-00	Trigger Assy, Handpiece	RP-14	36
15-3901-010-00	Nose Assy, Handpiece	RP-15	36
15-3926-028-00	Cord Assy, Handpiece	RP-16	34
15-3930-001-00	Motor Assy, Hi-Spd Handpiece	RP-17	35
15-3901-001-00	Motor Assy, Lo-Spd Handpiece	RP-18	36
22-15914-01-00	Connector, H/Pc Aspiration	RP-19	35
22-6589-000-00	O-Ring, H/Pc Aspir Valve	RP-20	36
22-5312-000-00	O-Ring, H/Pc Trigger Hshg	RP-21	36
15-3901-035-00	Mount Assy, H/Pc Switch	RP-22	36
22-15915-00-00	Valve, H/Pc Aspiration	RP-23	36
22-6727-000-00	Fuse, Battery, 3A 250V	RP-24	31
22-6715-000-00	Fuse, Fused Tub Assy, 250mA	RP-25	33

Table 4